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A REVISION OF THE MILLIPED GENUS BRACHORIA (POLYDESMIDA : XYSTODESMIDAE)

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Introduction

The present paper is an attempt to treat in a systematic manner one of the many groups of Diplopoda where revisionary attention has been sorely needed. Three previously recognized genera of the family Xystodesmidae will be considered. These are *Brachoria* Chamberlin, 1939, *Tucoria* Chamberlin, 1942, and *Anfractogon* Hoffman, 1948. Until the present time, 12 different specific names have been assigned to the genus *Brachoria*, five to *Tucoria*, and one to *Anfractogon*. Though it has long been understood that these three nominal genera are closely related, no attempt has been made to study their relationships carefully and thereby to ascertain the validity of the three generic names.

The primary considerations affecting the course of the present study have been fourfold. First is the consideration of the three genera *Brachoria*, *Tucoria*, and *Anfractogon* and their validity as separate taxonomic entities. Second is the evaluation of all specific names based upon members of this group. Third is the provision of accurate descriptions and illustrations of those forms which appear to be valid. Fourth is the description of all new forms which have been found in the course of this study.

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Specimens in the collections of the Chicago Natural History Museum, the United States National Museum, the Academy of Natural Sciences of Philadelphia, the Carnegie Museum, and the private collections of Mr. R. L. Hoffman and of the author were examined. Dr. Nell B. Causey of the University of Arkansas kindly lent the type specimens of *Brachoria benderi* and *Tucoria calceata* for study.

Inasmuch as the value and accuracy of a paper such as this depends in large part on certainty of identification, great effort was made to examine the type specimens of previously described species whenever possible. I personally examined the holotypes of the following:

Fontaria indianae Bollman
Fontaria glendalca Chamberlin
Fontaria kentuckiana Causey
Cleptoria splendida Causey
Brachoria brachypus Chamberlin
Brachoria separanda Chamberlin
Tucoria dynama Chamberlin
Anfractogon tenebrans Hoffman
Tucoria viridicolens Hoffman
Brachoria hansonia Causey
Brachoria benderi Causey
Tucoria calceata Causey

Dr. R. V. Chamberlin of the University of Utah was kind enough to compare *Brachoria* specimens sent him by the author with his holotypes of *B. initialis*, *B. eutypa*, and *B. ethotela*. Thus I have been able to examine metatypes of these three species.

Several specimens in the personal collection of R. L. Hoffman are undoubtedly conspecific with *Brachoria electa* Causey.

It is thus apparent that in the course of this study specimens of all the named forms in this genus except *Fontaria ochra* Chamberlin and *Brachoria sequens* Chamberlin have been examined. Personal communications from Dr. Chamberlin have supplied information concerning these two forms.

One thing that in the past has caused much confusion in this group has been the lack of uniformity in the methods of illustrating the male gonopods, which provide the most important taxonomic characters for the group. For each genus, certain appropriate positions of the gonopods should be chosen and care should be taken that all drawings are made from as nearly the same angle as possible. Many needless synonyms would have been avoided if this practice had been followed in the past. With structures as complicated as these, drawings made from different angles can readily give the impression of representing different species, and comparisons are extremely difficult.

The illustrations of the male gonopods used in this paper were made using a binocular microscope fitted with an ocular reticule. The left gonopod was removed from the animal and placed on a bit of cotton submerged in alcohol in a watch glass, great care being taken to orient the gonopod into the precise position required. Most gonopods were then drawn from three views, cephalic, caudal, and mesial. In two instances the mesial view was omitted and a ventral view sub-

stituted for it. In a few cases the caudal view was omitted inasmuch as it did not show any important characters not already shown. The cephalic and caudal views of all species were drawn from as nearly the same angle as possible, and the entire gonopod was shown. In the mesial views, however, no attempt was made to make all drawings from the same angle, the gonopods being oriented so as to show best the distinctive features of that particular species. Only the telopodite portions of the gonopods were shown in the mesial views. All setae were removed in order to show structures more clearly. All drawings were made to the same scale.

In the section of this paper devoted to species of the genus, where descriptions are given for each, the second form to be considered is the type species, *Brachoria initialis*. This form is described at some length and with attention to detail, but the descriptions of all other species are considerably shorter. The description of the type species may be considered to hold for all species of the genus in all details not specifically mentioned in the individual descriptions.

Sincere thanks are extended to Mr. Richard L. Hoffman for his constant help and advice during the course of this work. Mr. Hoffman suggested the subject for this study and lent many of the specimens used. Grateful acknowledgment is made of the constant help, suggestions, and encouragement extended by Dr. E. Craig Turner and Dr. R. D. Ross. I am also grateful to Mrs. J. M. Ogle and Mrs. R. E. Montgomery for aid in typing; to William C. Lund for help in the field; and to Dr. J. McD. Grayson for providing the position that made this study possible. The research for this paper was done in the biology department of Virginia Polytechnic Institute, Blacksburg, Va.

Genus *Brachoria* Chamberlin, 1939

Brachoria Chamberlin, Bull. Univ. Utah, biol. ser., vol. 5, No. 3, p. 3, 1939. Type: *Brachoria initialis* Chamberlin (=*Brachoria ochra initialis* Chamberlin), by original designation.

Tucoria Chamberlin, Bull. Univ. Utah, biol. ser., vol. 8, No. 2, p. 17, 1943. Type: *Fontaria kentuckiana* Causey, by original designation. New synonymy.

Anfractogon Hoffman, Proc. Biol. Soc. Washington, vol. 61, p. 94, 1948. Type: *Anfractogon tenebrans* Hoffman, by original designation.

ORIGINAL DESCRIPTION: The original description of the genus *Brachoria* was very short, mentioning only a few characters. The figure of the gonopods of the type species, *B. initialis*, was considered part of the generic description.

The description was as follows: "Relatively broad forms with wide carinae continuing slant of dorsum. The blade of telepodite simple, distally accuminate, of form shown in figure for generotype; large proximal portion sparsely setose, the distal portion smooth."

FUNDAMENTAL CHARACTERS: All members of this genus are broad with wide carinae or paranota as indicated by Chamberlin. This body form alone is enough to identify a specimen from southeastern United States as belonging to the group of genera of which *Brachoria* is a member. Other characters are needed, however, to separate *Brachoria* from closely related genera such as *Apheloria* and *Sigmoria*.

The original drawing of the male gonopods of the type species, *Brachoria initialis*, indicated that the telopodite portion of the gonopod forms an arc similar to that in related genera. There was one rather striking distinctive feature, however. This was the presence of a joint or cingulum (new term, from the Latin "cingulum," a girdle) in the telopodite, dividing it into a proximal setose portion and a distal glabrous portion. The presence of this cingulum has been used by all later workers as a distinctive generic character of *Brachoria*.

The later-described genera *Tucoria* Chamberlin and *Anfractogon* Hoffman also had a cingulum and were respectively distinguished from *Brachoria* by the greater bulk of the gonopods and the complexity of the terminal portion of the telopodite of the gonopods. These characters are shown below to be ineffective as distinguishing characters on the generic level. The reduction of the two names *Tucoria* and *Anfractogon* to synonyms of *Brachoria* allows use of the cingulum as the single most important diagnostic character of the genus.

No other taxonomic character has yet been found which will effectively distinguish *Brachoria* from other closely related genera. One character is sometimes useful in this regard, however. This is the shape of the paranota, which in many species of *Brachoria* are gently rounded forward at the caudolateral corners. Some species, however, have the caudolateral corners of the paranota produced caudad. All known species of the related genera *Apheloria* and *Sigmoria* show this caudad projection of the paranota to at least a small extent. Although it is possible to distinguish species with rounded paranota as belonging to the genus *Brachoria* without resort to the male gonopods, species with the caudolateral corners of the paranota produced caudad may or may not belong to this genus. For purposes of comparisons, the ninth segment is used in describing this feature. At mid-body level, variations in this character are very slight. Variations in the shapes of the paranota of the last three or four segments are very difficult to compare and are of little taxonomic value.

The paranotal swellings are usually weakly developed in species of *Brachoria* but it is difficult to use this character accurately as the differences are very slight.

It is indeed unfortunate that so far no good character other than the structure of the male gonopods has been found to be diagnostic of the genus. The cyphopods are apparently the same for all species. This, of course, leaves the identification of females a very difficult, if

not impossible, undertaking. Females with rounded paranota may be identified as *Brachoria* with some degree of assurance. Females of species which do not show this character cannot be identified even to genus unless they are found with the males or unless they are gravid and males can be reared from the eggs which they produce. All females treated in this paper were found with males and identified on that basis.

On the specific and subspecific levels, the male gonopods once again provide the best taxonomic characters. Their shape, relative bulk, and complexity form reliable criteria for separation of the various forms. The major features of the telopodite portion show little variation and the experienced worker can easily predict the extent of this individual variation even if only a few specimens are at hand.

The size of the gonopods has been found to be fairly consistent at the species level except in the case of *separanda* where the great variation may be correlated with geographical distribution. The size of the gonopods is indicated in the descriptions by two measurements, the telopodite arc length and the telopodite arc width. The first of these measurements is made in a plane perpendicular to the telopodite base line and is the distance from the base of the telopodite to the most distant point on the arc measured in a straight line. The arc width is measured in a plane perpendicular to the plane of the preceding measurement and is the greatest outside diameter of the arc. For further explanation of these measurements see the drawings of the gonopod of *initialis* in figure 1*a*.

One gonopod character which has been found to vary somewhat extensively, however, is the size of the prefemoral spine (compare figs. 3*a*, 3*g*). Though in some species this is apparently a rather stable character, in others it varies considerably. If the spine is not only long but of a rather heavy and sturdy form, it usually does not show much variation. If it is very slender in form even if sometimes quite long, it will apparently exhibit much individual variation. *Brachoria insolita* is a species that shows much variation in this character (see fig. 6*e*).

The shape of the collum varies somewhat from species to species, but the differences are so slight they are very difficult to use as taxonomic characters. The development of the paranotal swellings on the collum and of the ridges running from them along the cephalic edges of the paranota are of considerable use as specific characters. They show slight individual variation.

The extent of development of the coxal armature has in the past been considered of some value. This has been found to be quite a variable character, however, and would seem to be of little value except, perhaps, as an aid in separating two species where the typical

sizes of armature lie at the two extremes. Females always show stronger armature than males.

The extent of development of sternal processes between the 3d–6th pairs of legs has been mentioned commonly in the past. The present study has indicated that these structures are not reliable as taxonomic characters inasmuch as they often vary all the way from total absence to strong development in specimens of the same species collected at the same locality. Females do not show these sternal characters at all. Variations in the postgenital sternites are of no taxonomic value.

The shape of the preanal scale shows great individual variation but no consistency of taxonomic value.

Both the body length and body width have also been found to vary greatly and hence their use as taxonomic characters is difficult. Females are always larger than males.

Color has often been used in the past as a specific level character in the Xystodesmidae. Hoffman (1950, 1951), however, has found that color is often at best only a subspecific character in this family. This study tends to confirm his findings (see *Brachoria calcaria*, new species, p. 15).

Notes on synonymy: Chamberlin (1943) established *Tucoria* as a new genus to include the two species described by Causey (1942) as *Fontaria kentuckiana* and *Cleptoria splendida*. Although in both of these species a cingulum divides the telopodite of the male gonopods into two portions just as in *Brachoria*, Chamberlin believed them to be generically distinct because of the noticeably heavier bulk and greater complexity of the terminal portion of the telopodite. The three other species subsequently described in this genus—*T. dynama* Chamberlin, *T. viridicolens* Hoffman, and *T. calceata* Causey—show this same type of form. All the "*Tucoria*" species are obviously fairly closely related to each other. The genus has been known only from the State of Kentucky.

Hoffman (1948b) published a key to the species of *Tucoria* in which he used the form of the prefemoral spine. Causey (1955) later claimed that this character is the most diagnostic one for the genus. She stated that the spine is always "well-developed, cylindrical, and acute" in *Brachoria* while it is variable in *Tucoria*, being "either almost absent, peglike, or triangular."

The new forms described in the present paper provide evidence that neither of the above characters will hold for genera. The new species *Brachoria hoffmani* and *B. laminata* from southwestern Virginia, though not closely resembling any of the previously known forms of *Tucoria*, might on the basis of the bulk of their gonopods be put into that genus. The new species *Brachoria turneri*, however, presents more of a problem. The form of its gonopods is much more like

that of the average *Brachoria* but the bulk is considerably greater than is usual in that genus. If *turneri*, which is somewhat intermediate in bulk, is in *Tucoria*, the question of the new species *ligula* and *hubrichti* immediately arises. The bulk of their gonopods is not much less than *turneri* yet they closely approach the relative bulk of such *Brachoria* species as *ochra*, *electa*, and *glendalea*. Thus it becomes obvious that this character is not effective in separating *Tucoria* and *Brachoria* inasmuch as the presently known species form such a continuum that it is impossible to say where dividing lines should be.

In the case of the prefemoral spine as a generic character, attention is called to the two new species *Brachoria hoffmani* and *B. laminata*. Though these are *Tucoria*-like in bulk, they both show very strong development of cylindrical, acute, prefemoral spines. Thus, using Causey's criterion, they would be assigned to *Brachoria*. At the other extreme, however, a specimen of *eutypa* from North Carolina, though typical of *Brachoria* in bulk, shows practically no development of the prefemoral spine. It would, as a result, be placed in *Tucoria* if the spine were used as a generic character. The new species *Brachoria dentata* is also more like the typical *Brachoria* than *Tucoria* in all respects except the spine which is nearly absent. The final and strongest argument is, however, the fact that this character has been found to exhibit considerable individual variation. The case of *B. eutypa* mentioned above is an example. Most specimens of this subspecies have well-developed spines while the single North Carolina specimen does not. Likewise study of a series of specimens of the new species *insolita* shows variation in the spine from near nonexistence to moderate development. Thus this character cannot be used to separate *Tucoria* and *Brachoria*.

Careful study has not revealed even a single character that will make possible a consistent and meaningful separation of *Tucoria* from *Brachoria*. It is, therefore, my opinion that *Tucoria* must fall as a synonym of *Brachoria*.

The genus *Anfractogon* was described by Hoffman (1948a) to include the species *tenebrans* from Alabama. Hoffman stipulated three characters as diagnostic of the genus. The first was the processes on the sternites of the third, fourth, and fifth legs of the male. This study has shown that processes are always present in *Brachoria* on the sternites of the third and fourth legs and that those on the sternite of the fifth legs are quite variable.

The second character mentioned by Hoffman was the form of the prefemoral spine. This has already been shown in the discussion of *Tucoria* to be a variable character and of no value on the generic level.

The third character was the much-modified distal end of the male gonopod. The species recently described by Causey as *Brachoria*

electa shows some modification of this type, although in all other respects it so closely resembles the type species *Brachoria initialis* that it may in the future have to be reduced to a subspecies of *ochra*. The new species *B. hoffmani* shows modification similar in some respects to *Anfractogon tenebrans*. Furthermore, a specimen of *tenebrans* from northern Alabama does not exhibit as much modification as does the type specimen of the species and appears in every way typical of the genus *Brachoria*.

Inasmuch as no character has been found by which *Anfractogon* may be separated from *Brachoria*, it is my opinion that *Anfractogon* must fall as a synonym of *Brachoria*.

Diagnosis: A xystodesmid genus with telopodite of male gonopod bisected by a cingulum dividing it into proximal setose region and distal glabrous region. Telopodite forming arc variable in both size and complexity. Gonopod aperture subovoid, cephalic side slightly indented.

Body broad, length 3.5–4.9 times the width; length 30–52 mm.; width 6.5–12.5 mm. Paranota wide, usually overlapping, those of ninth segment often with caudolateral corners not produced caudad or if produced, usually only slightly so. Paranotal swellings usually not strongly developed, often almost lacking on collum and on 2d segment. Repugnatorial pores distributed in normal manner for the family, opening dorsally in paranotal swellings. Antennal sensory cones, 4.

Range: Southeastern United States: Alabama and Mississippi north to southern Indiana, West Virginia, and extreme western Maryland, and east to southwestern Virginia and western North Carolina.

Species: 25, two of which have an additional subspecies.

Key to known species and subspecies of *Brachoria*

1. Precingular portion of telopodite of male gonopod much shorter than postcingular portion 2
   Precingular portion subequal or longer than postcingular portion . . . 3
2. A tooth present on the anterior side of the postcingular portion of the telopodite (fig. 2*e*) . . . . . **dentata**, new species (p. 18)
   A tooth present on the posterior side of the postcingular portion of the telopodite (fig. 6*d*) . . . . . **insolita**, new species (p. 36)
3. One or more spines on the cephalic side of the precingular portion of the telopodite (fig. 1*d*,*g*) . . . . . **calcaria**, new species (p. 15)
   No spines on the precingular portion of the telopodite 4
4. Solenomerite large and conspicuously pectinate (fig. 6*i*).
   kentuckiana (Causey) (p. 38)
   Solenomerite small or not pectinate, or no solenomerite present 5
5. Postcingular portion of telopodite with four sharp spines on outer surface (fig. 9*h*) . . . . . **viridicolens** (Hoffman) (p. 50)
   No spines on outer surface of telopodite 6

6. A large, rather thin terminal plate on distal end of telopodite 7
   No such thin terminal plate present 8
7. Terminal plate longer than broad, its distal portion strongly curved (fig. 5*d–f*) . . . . . **hoffmani**, new species (p. 31)
   Terminal plate about as broad as long, its distal portion not curved (fig. 7*a*). **laminata**, new species (p. 39)
8. Telopodite very simple and slender, forming a large, continuous arc with no abrupt bends, the distal end acuminate (fig. 5*a*) . **hansonia** Causey (p. 31)
   Telopodite of gonopod not as described 9
9. Telopodite noticeably swollen just beyond the cingulum, abruptly narrowing again more distally 10
   Telopodite not noticeably swollen just beyond the cingulum, or if so, not becoming abruptly slender more distally 11
10. Distal portion of telopodite twisted (fig. 8*b*) . . **plecta**, new species (p. 43)
    Distal portion of telopodite not twisted, simple, the end acuminate (fig. 8*h*). **separanda** Chamberlin (p. 44)
11. Pronounced ridges present along cephalic margins of paranota of collum . 12
    Ridges absent or very weak 23
12. Postcingular portion of telopodite of gonopod bent cephalically at a right angle when viewed mesially (fig. 1*i*) . . . . . **calceata** (Causey) (p. 16)
    Postcingular portion of telopodite not so shaped 13
13. Telopodite small, slender, forming a simple arc, but with a sharp bend in the postcingular portion; the distal portion not curving back close to the precingular shaft 14
    Gonopod not as described 16
14. The bend not extremely sharp, the telopodite narrowing very abruptly beyond the bend thereby forming a pronounced shoulder at the bend; the distal portion of the telopodite dagger-like with a very acute point (fig. 2*a–c*) . . . . . **cedra**, new species (p. 17)
    The bend very sharp; the telopodite not narrowing so abruptly nor forming such a noticeable shoulder, the distal portion not dagger-like (fig. 1*a–c*) 15
15. Distal end of telopodite acuminate (fig. 1*a*) . **ochra initialis** Chamberlin (p. 11)
    Distal end of telopodite more blunt . . **ochra ochra** (Chamberlin) (p. 10)
16. Postcingular portion of telopodite with a very pronounced caudally directed twist about midway of its length (fig. 2*g,h*) . . . **electa** Causey (p. 20)
    Telopodite with no such twist 17
17. Entire telepodite arc completed quite distant from telopodite base; postcingular portion of telopodite relatively broad, thin, and flat, with no hook in the distal portion and no distinct solenomerite (fig. 4*d–f*). **glendalea** (Chamberlin) (p. 28)
    Gonopod not as described 18
18. Distal end of telopodite with a distinct solenomerite set off from main portion of telopodite 19
    No distinct solenomerite 20
19. Telopodite rather flat and moderately broad, forming a continuous arc, the solenomerite tongue-like in shape (fig. 7*d*) . . **ligula**, new species (p. 40)
    Telopodite very bulky, with a strong ridge along cephalic side of distal half of postcingular portion (fig. 8*d*) . . . . . **splendida** (Causey) (p. 47)
20. Gonopod small, less than 1.7 mm. in telopodite arc length and 1.2 mm. in telopodite arc width; the arc rather slender and simple with no hook in the distal portion (fig. 6*a–c*). . . . . **indianae** (Bollman) (p. 34)
    Gonopod larger, more than 1.8 mm. in telopodite arc length and 1.3 mm. in telopodite arc width; the arc either not so slender or with a hook in the distal portion 21

21. Telopodite simple, with no hook in the distal portion, the end blunt (fig. 5*g*). **hubrichti,** new species (p. 33)
A hook in the distal portion of the telopodite 22
22. The hook elaborate, involving more than just the extreme distal end of the telopodite (fig. 9*c,d*) . . . . . **tenebrans** (Hoffman) (p. 48)
The hook not elaborate, being only slightly bent, involving only the extreme end of the telopodite (fig. 3*a,e*) . . . **eutypa eutypa** Chamberlin (p. 21)
23. Distal portion of posteingular part of telopodite arc curving in a plane subparallel to the body, never curving back dorsally towards the body; prefemoral spine very large (fig. 7*g,h*) . . **mendota,** new species (p. 42)
Distal portion of telopodite curving back dorsally towards the body . . 24
24. Posteingular portion of telopodite very thin and weak, the distal part flattened into a sickle-shaped blade (fig. 4*a–c*) . **falcifera,** new species (p. 27)
Gonopod not as described 25
25. Telopodite heavy and broad for most of its length (fig. 9*e*). **turneri,** new species (p. 49)
Telopodite not heavy and broad 26
26. A strongly developed hook in the distal end of the telopodite, the portion forming the hook much reduced in size from the portion just proximal to the hook (fig. 4*g*) . . . . . **hamata,** new species (p. 30)
Extreme distal portion of telopodite somewhat hooked but the portion forming the hook not much, if any, reduced in size from the portion proximal to the hook 27
27. A swelling present on the telopodite just proximal to the hook (fig. 3*h,j*). **eutypa ethotela** Chamberlin (p. 23)
No such swelling present (fig. 3*f*) . . **eutypa eutypa** Chamberlin (p. 21)

Brachoria ochra ochra (Chamberlin)

Fontaria ochra Chamberlin, Psyche, vol. 25, pp. 123–124, 1918.
Brachoria sequens Chamberlin, Bull. Univ. Utah, biol. ser., vol. 5, No. 3, p. 4, fig. 2, 1939. New synonymy.
Brachoria ochra, Chamberlin and Hoffman, U. S. Nat. Mus. Bull. 212, p. 25, 1958.

ORIGINAL DESCRIPTION:

The types are in general fulvous, with the legs and antennae yellow, in most somewhat darker across the anterior region of the somites, though in the darkest individual of all the darkest part of the somite is in a narrow stripe slightly in front of the caudal margin. The general color appearance is much like that of *F. crassicutis* Wood. The carinae in some are somewhat paler than the intervening region.

Body obviously narrowed at both ends, the sides over most of the length being parallel or nearly so. Lateral carinae moderately large, not raised at angle to general slope of somites excepting in caudal region. Posterior margin of carinae in anterior region straight, slightly bent caudad in middle region, more so in posterior region, but only the last few acutely angularly produced.

Vertigial sulcus distinct, ending abruptly at or a little above upper level of antennal sockets. Occipital foveolae 2+2.

In the male the sternites and the coxae are without special processes.

In the gonopods of the male the principal or distal division is stout at the base and narrows gradually distad; it extends ventrad and then curves across to the other gonopod and then coils dorsad; near the point where it begins the bend dorsad it is somewhat geniculate, the portion beyond the geniculation being more slender and somewhat doubly or sigmoidally curved with the acute tip bent

mesad almost at right angles; it is densely pilose at base on the mesal side and less strongly so along the edge to near the level where the bend across to the other side begins. The basal process is short, straight and acute and extends obliquely caudomesoventrad to near the tip of the principal process of the opposite gonopod.

Length of type (male) about 35 mm.; width, 10 mm.

Locality: Mississippi: Agricultural College. Six specimens collected in the fall of 1916 by J. W. Bailey.

Since I have not personally examined a specimen of *B. ochra ochra* and thus am unsure of the details of many characters, no new description of this subspecies is given in the present paper. Chamberlin's original description is quoted above in its entirety.

TYPE SPECIMEN: Male holotype in the private collection of R. V. Chamberlin. Female and immature paratypes in the Museum of Comparative Zoology.

TYPE SPECIMEN OF SYNONYM: Type of *Brachoria sequens* in the private collection of R. V. Chamberlin.

***Brachoria ochra initialis* Chamberlin, new combination**

FIGURE 1*a–c*

Brachoria initialis Chamberlin, Bull. Univ. Utah, biol. ser., vol. 5, No. 3, pp. 3–4, fig. 3, 1939.

Brachoria brachypus Chamberlin, Proc. Acad. Nat. Sci. Philadelphia, vol. 99, pp. 26–28, fig. 9, 1947. New synonymy.

Brachoria benderi Causey, Ent. News, vol. 61, pp. 193–195, figs. 1, 2, 1950. New synonymy.

DIAGNOSIS: Distinguished from all other species of the genus except *electa, indianae, cedra,* and *separanda* by the small size and bulk and simple form of the male gonopods. Differs from *electa* in lacking a caudally directed twist in the terminal portion of the telopodite, and from *indianae, cedra,* and *separanda* in the exceedingly sharp nature of the bend forming a ridge in the postcingular portion of the telopodite. Differs from *ochra ochra* in the subacuminate distal end of the telopodite.

DESCRIPTION: Length of holotype, 37 mm.; width, 10.2 mm.; length of other specimens, 30–38 mm.; width, 7–12 mm.

Tergites somewhat flattened, paranota wide, continuing slope of dorsum; very finely coriaceous; prozonites smooth. Body gently tapering caudad from midbody region to segment 18, then much more abruptly to end of telson.

Collum subellipsoidal, posterior edges of paranota directed slightly cephalad from their bases, margins only faintly curved; ends of paranota very narrowly rounded, caudolateral corners of paranota rather sharp; paranotal swellings weakly evident, pronounced ridges extending from them along cephalic margins of paranota to points slightly above anterior bases of paranota.

Tergites of segments 2 and 3 not of full width or length. Caudolateral corners of paranota rather sharply rounded. Paranotal swellings present.

Tergite of segment 4 of normal width but slightly shorter than succeeding ones. Paranota and paranotal swellings like those of segements 2 and 3.

Tergites of segments 5–16 similar to each other in both length and width. Caudolateral corners of paranota becoming increasingly produced caudad, this condition marked at level of 9th segment. Posterior edges of paranota of segment 13 and all succeeding segments noticeably directed caudad. Paranotal swellings strong.

Paranota of segments 17 and 18 rather sharply triangular. Paranotal swellings very strong.

Anal segment subtriangular in dorsel aspect, apex truncate; two small subterminal lateral tubercles present.

Anal valves inflated, unsculptured, with prominent mesial ridges; the usual setiferous tubercles present.

Preanal scale variable in shape, sometimes subtriangular with the two lateral tubercles well below level of terminal protuberance and base of scale almost straight, sometimes subellipsoidal with the two lateral tubercles on nearly same level as terminal protuberance and base of scale strongly curved.

Vertigial sulcus of head distinct, ending little above upper level of antennal sockets. Occipital foveolae 2+2, moderately distinct; antennal foveolae 1+1, very indistinct; clypeal foveolae 1+1, very distinct. Antennal article 2 the longest, 3–6 subequal; articles 1–4 only sparsely hirsute, 5–6 heavily hirsute; antennal sensory cones 4. Mouthparts typical of the family Xystodesmidae.

Sternum of 3d pair of legs with prominent pair of somewhat fused processes; sterna of 4th and 5th legs each with a pair of small, separate processes; sternum of 6th legs smooth.

Second pair of legs with usually clyindrical, distally truncate, seminal lobes. Pregenital limbs heavily hirsute, without spines on prefemora.

Coxae and prefemora of postgenital legs small, their combined length subequal to that of 3d podomere; 4th and 5th podomeres shorter than 3d, subequal; 6th podomere slightly longer than 4th and 5th. Strong, gently curved claws present. Prefemora of postgenital legs heavily armed. Coxal armature weak to moderate.

Gonopod aperture ovoid, cephalic side slightly indented, caudal margin with prominent flange. Male gonopods small (about 1.58–1.74 mm. in telopodite arc length and 0.90–1.04 mm. in arc width); simple in form; curved mesiad, distal end bent very sharply dorsad; tip

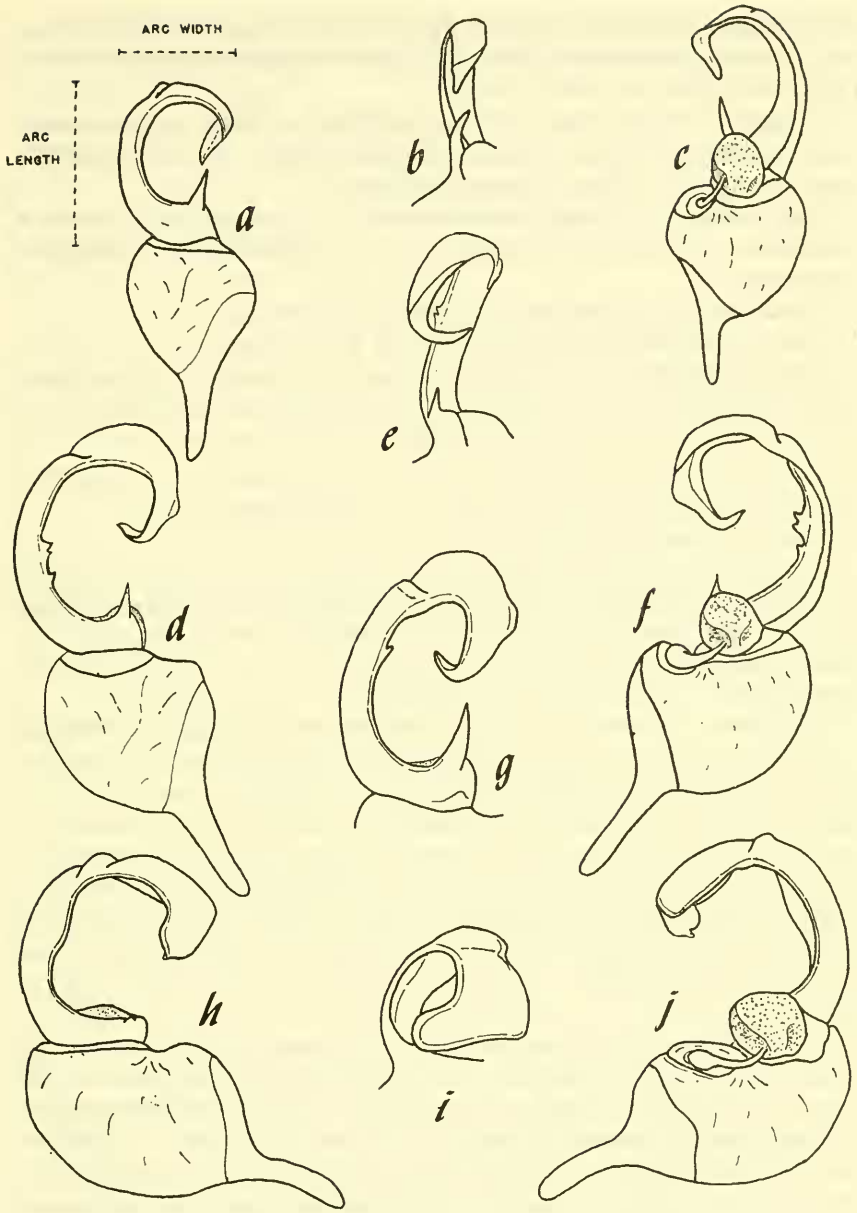

FIGURE 1.—Left male gonopods of species of *Brachoria*. *a–c*, *B. ochra initialis:* cephalic, mesial, and caudal views. *d–g*, *B. calcaria: d–f*, cephalic, mesial, and caudal views of holotype; *g*, cephalic view of specimen from near Hinton, W. Va., showing larger gonopod with only one spine. *h–j*, *B. calceata:* cephalic, mesial, and caudal views.

subacuminate; cingulum located at point of strongest mesial curvature; precingular portion of telopodite longer than postcingular portion. Prefemoral spine moderately strong.

Cyphopods large, their aperture bordered caudally by weak marginal lip; receptacle large and strong; both valves with small median dorsal concavity; valves subequal in length.

Color faded in all specimens examined by the author. Causey's description of *benderi* indicates color was dark brown with bright pink on paranota.

TYPE LOCALITY: Maplesville, Chilton County, Ala.

TYPE SPECIMEN: Private collection of R. V. Chamberlin.

TYPE SPECIMENS OF SYNONYMS: Types of *Brachoria brachypus* and *Brachoria benderi* in the Academy of Natural Sciences of Philadelphia.

PUBLISHED DISTRIBUTION RECORDS:

MISSISSIPPI: Rankin County: Piney Woods (type locality of *benderi*). TENNESSEE: Roan County: Harriman (type locality of *brachypus*).

NEW DISTRIBUTION RECORDS:

ALABAMA: Lauderdale County: 8½ miles northeast of Florence, Dec. 12, 1937 (1 ♂), J. P. E. Morrison. Lee County: Chewacla State Park, May 6, 1954 (1 ♂, 1 ♀), Hubricht. Tuscaloosa County: Tuscaloosa, Mar. 29, 1948 (1 ♂), George Ball. TENNESSEE: Anderson County: Clinch River bluff, 4 miles southwest of Clinton, May 10, 1951 (1 ♂), Hubricht.

DISCUSSION: Inasmuch as only female and immature paratypes are present in the Museum of Comparative Zoology, and no drawings were included in the original description, the identity of *ochra* has long been in doubt. Personal communications with Dr. Chamberlin now make it possible to clear up the matter. A sketch of the gonopods of *ochra* made by Chamberlin resembles exactly the drawing of *Brachoria sequens* published by Chamberlin in 1939. Thus *sequens* must be considered a junior synonym of *ochra*. The two were described from the same type locality—Agricultural College, Oktibbeha County, Miss.

At my request, Chamberlin kindly compared a specimen of *B. benderi* Causey (=*B. initialis* Chamberlin) with his specimens of *B. ochra* and found that they were very similar. The only difference that he found was in the terminal portion of the male gonopods. In *benderi* the terminal division is smaller, with the apical portion straight and acute, while in *ochra* it is longer, more lamellate, bent at the distal end into a somewhat spoon-like shape, and not so acute. Chamberlin suggested that this difference might be varietal only. Careful examination of all available specimens has convinced me that this is actually the case and that the two forms are at best only subspecifically distinct.

A specimen from near Tuscaloosa, Ala., was sent to Chamberlin who compared it with the holotype of *B. initialis*. He found the two to be

identical. This metatype specimen of *initialis* has been used in my decisions concerning synonymy and is also the basis for the description of the form given above.

Careful comparison of the metatype of *B. initialis* with the holotypes of *B. benderi* Causey and *B. brachypus* Chamberlin has shown that the three are conspecific and do not exhibit sufficient differences to warrant even subspecific designations. Thus both *benderi* and *brachypus* must be submerged as synonyms of *B. initialis,* which must in turn now be designated as *Brachoria ochra initialis.*

In the original descriptions of both *sequens* and *brachypus,* Chamberlin mentioned the presence of a second joint in the telopodite of the male gonopod. Examination of many specimens, including the holotype of *brachypus,* has convinced me that there is only one true "joint" or cingulum present, the more distal structure being actually only a very sharp and abrupt bend in the telopodite.

It is interesting to note that the range of *B. ochra initialis,* as now conceived, is by far the largest one known for any form of *Brachoria.* Specimens are known from four widely separated locations in Alabama, from one locality in Mississippi, and from two locations in Tennessee.

Specimens of *B. ochra initialis* vary considerably in body size. This variation is apparently not correlated with geographical distribution. It is exceedingly interesting to note that, regardless of body size, the size of the gonopods varies only slightly.

Brachoria calcaria, new species

FIGURE 1*d–g*

DIAGNOSIS: Distinguished from all other species of the genus by the presence of one or more spines on the precingular portion of the telopodite of the male gonopod. Shows a banded color pattern while the closely related species *B. separanda* usually shows a trimaculate pattern.

DESCRIPTION: Length of male holotype, 38 mm.; width, 10 mm.; length of other males, 38–43 mm.; width, 9–10.5 mm.; length of female, 49 mm.; width, 10 mm.

Collum with ends rounded; paranotal swellings and ridges absent.

Paranotal swellings absent on 2d segment, weakly present on 3d segment, moderate on 4th and all succeeding segments. Paranota of segment 2 and all succeeding midbody segments rounded.

Sternum of 4th pair of legs with pair of weak processes; sternum of 5th legs with pair of very small mounds; sternum of 6th legs with transverse ridge.

Coxal armature moderate to strong.

Male gonopods of medium size (about 2.0 mm. in telopodite arc length and 1.7 mm. in arc width); curving mesiad, then dorsad, then caudolaterad, all in relatively smooth curves; portion of telopodite

just distal to cingulum distinctly swollen; a small, thin flange present on caudomesial surface of postcingular portion of telopodite at about midpoint of its length (this flange not present in the closely related species *separanda*); extreme distal portion of telopodite tapering to acute point. Variable number (usually 1–4) of small spines present on precingular portion of telopodite at about midpoint of its length; size of spines variable. Prefemoral spine moderate.

Color variable; very dark brown above with entire caudal edge of tergites brightly colored, these bands sometimes bright red (Riner specimens and some Blacksburg specimens, including the holotype), sometimes bright lemon yellow (West Virginia specimens), and sometimes red on paranota and yellow on dorsum or red on anterior segments and yellow on posterior 3 or 4 segments including the telson (some Blacksburg specimens); a light median spot on cephalic edge of collum; underparts straw-colored.

TYPE LOCALITY: Blacksburg, Montgomery County, Va.

TYPE SPECIMENS: Male holotype collected by W. C. Lund, June 26, 1956. Male and female paratypes collected by L. T. Richardson, June 26, 1956, at Riner, Montgomery County, Va. All type material is in the U. S. National Museum.

OTHER DISTRIBUTION RECORDS:

WEST VIRGINIA: Summers County: about 10 miles southeast of Hinton on Route 12, July 16, 1956 (2 ♂, 1 ♀), Hoffman. VIRGINIA: Montgomery County: Blacksburg, Dec. 9, 1956 (2 ♂), Hoffman. Three males with no collection labels found in the collections of the Biology Department of Radford College; the evidence seems to indicate that they were collected near Radford, Va., in the early part of this century.

DISCUSSION: *Brachoria calcaria* resembles *B. separanda* in the general form and shape of the male gonopods, and I at first considered describing it as a subspecies of the latter species. Further study indicated that this was not advisable, however, inasmuch as there appears to be no evidence of intergradation of the distinguishing characters. The known ranges of the two species are not far distant from one another yet all specimens are fully distinct.

The enormous variation in color in this species is of special interest. It serves to call attention to the very close relationship of red and yellow pigments in many millipeds.

***Brachoria calceata* (Causey), new combination**

FIGURE 1*h–j*

Tucoria calceata Causey, Proc. Biol. Soc. Washington, vol. 68, p. 28, figs. 4, 5, 1955.

DIAGNOSIS: Distinguished from all other species of the genus except *tenebrans* by the prominent right angle bend in mesial view of the postcingular portion of the telopodite of the male gonopod, the distal por-

tion of which is not thin or plate-like. Differs from *tenebrans* in lacking the hook-shaped distal end of the telopodite.

DESCRIPTION: Length of male holotype, unknown; width, 10 mm.

Collum subellipsoidal, edges gently curved, ends of paranota narrowly rounded; paranotal swellings absent; moderately strong ridges along cephalic margins of paranota.

Paranotal swellings absent from segment 2, weakly present on segments 3 and 4, rather strong on segment 5 and all succeeding segments. Paranota of segments 2–4 rounded, those of segment 5 and all succeeding midbody segments rather square in shape; paranota of posterior segments bluntly triangular, the apexes rounded.

Sternum of 3d pair of legs with the usual processes; sternum of 4th legs with a pair of weak processes; sternum of 5th legs with a pair of small rounded mounds; sternum of 6th legs with no processes.

Coxal armature weak to moderate.

Male gonopods of medium size (about 1.85 mm. in telopodite arc length and 1.8 mm. in arc width); curved cephalomesiad, then cephalodorsad, then laterad; postcingular portion of telopodite short, heavy, boot-shaped, with small terminal solenomerite; precingular portion longer than postcingular portion. Prefemoral spine reduced to a very small nub.

Color completely faded.

TYPE LOCALITY: Tyrone, Anderson County, Ky. Known only from the type locality.

TYPE SPECIMEN: In American Museum of Natural History.

Brachoria cedra, new species

FIGURE 2*a–c*

DIAGNOSIS: Distinguished from all other species of the genus except *ochra*, *electa*, *separanda*, and *indianae* by the small size and simple form of the male gonopods. Differs from those species in the abrupt narrowing of the distal part of the postcingular portion of the telopodite of the gonopod.

DESCRIPTION: Length of male holotype, 36.5 mm.; width, 10 mm.

Collum subellipsoidal, ends of paranota moderately rounded; paranotal swellings very weak; ridges present along cephalic edges of paranota.

Paranotal swellings very weak on segment 2, slightly stronger on segments 3–5, moderately strong on segment 6 and all succeeding segments. Paranota of segment 2 and all succeeding segments square.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with a pair of small but quite evident processes; sternum of 5th legs with a pair of low mounds; sternum of 6th legs smooth.

Coxal armature weak.

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Male gonopods rather small (about 1.78 mm. in telopodite arc length and 1.20 mm. in arc width); simple in form; curving mesiad, then rather abruptly dorsad; telopodite narrowing abruptly at latter bend forming slender solenomerite which comes to acute point; prominent shoulder on caudal side of telopodite at point of abrupt narrowing; precingular portion of telopodite longer than postcingular portion. Prefemoral spine moderate.

Color faded, indicates a possible trimaculate pattern.

TYPE LOCALITY: Cedar glades near Jonesville, Lee County, Va. Known only from the type locality.

TYPE SPECIMEN: Collected by Loyd Carr, May 1955. Male holotype deposited in the U. S. National Museum.

DISCUSSION: The resemblances between this species and *B. ochra* are very marked and this form may eventually be shown to be only subspecifically distinct from *B. ochra*. For the present, however, it seems best to treat the two separately inasmuch as the differences are easily seen and the variation shown by *B. ochra* throughout its unusually large range is so slight as to make one wonder if it might not eventually be found in its typical form in the area of southwestern Virginia where *B. cedra* is known to occur.

Brachoria dentata, new species

FIGURE 2*d–f*

DIAGNOSIS: Distinguished from all other species of the genus except *insolita* by the position of the cingulum on the telopodite of the male gonopod and by the tooth on the postcingular portion. Differs from *insolita* in that the tooth is on the cephalic side of the telopodite in this species while it is on the caudal side in *insolita*. The distal portion of the telopodite of *dentata* does not bend sharply cephalad as does that of *insolita*.

DESCRIPTION: Length 40 mm.; width 11 mm.

Collum ellipsoidal; posterior edges of paranota curving gently cephalad from their bases; ends of paranota not so narrowly rounded; paranotal swellings not noticeable; pronounced ridges extending from ends of paranota along their cephalic margins to points at anterior bases of paranota.

Caudolateral corners of paranota of 2d and all succeeding segments becoming increasingly squared; those of 9th segment quite square. Paranotal swellings almost lacking on second segment; only weakly present on succeeding segments.

Processes on sterna of 3d, 4th, and 5th pairs of legs prominent; sternum of 6th legs smooth.

Coxal armature moderate.

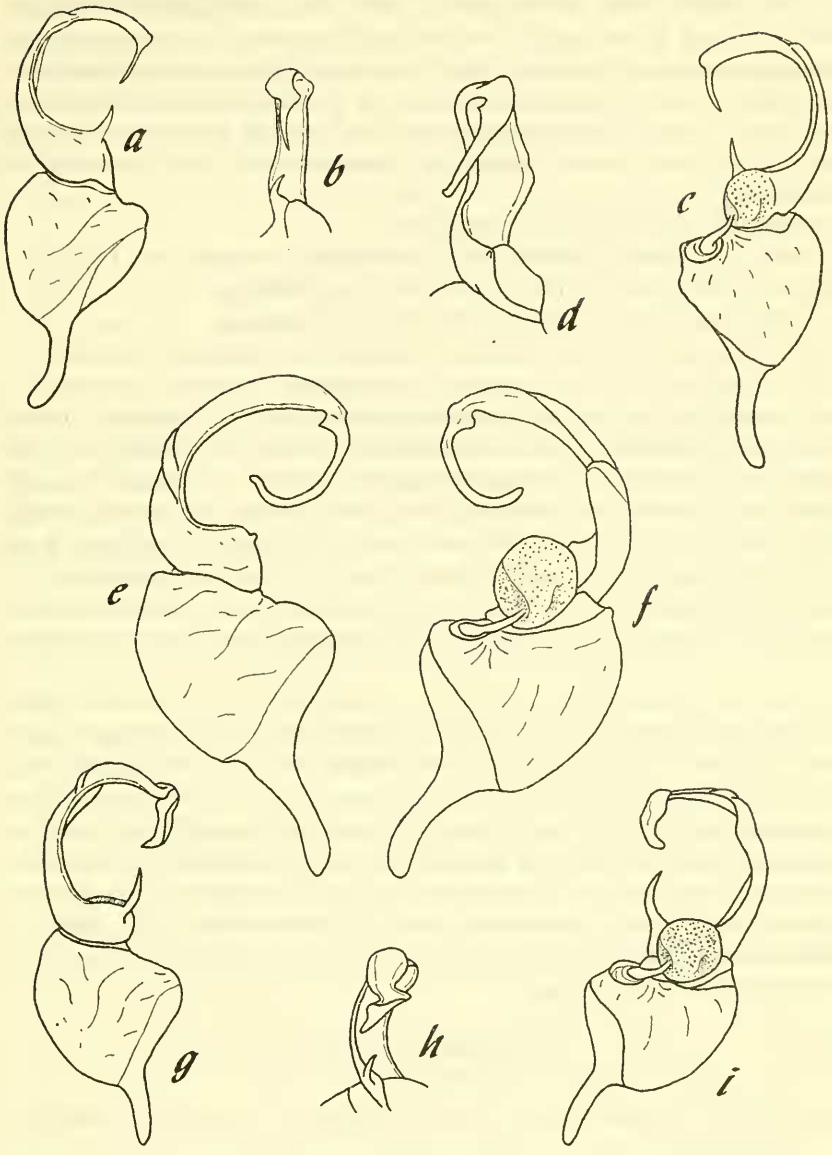

FIGURE 2.—Left male gonopods of species of *Brachoria*. *a–c*, *B. cedra:* cephalic, mesial, and caudal views. *d–f*, *B. dentata:* mesial, cephalic, and caudal views. *g–i*, *B. electa:* cephalic, mesial, and caudal views.

Gonopods of medium size (about 2.08 mm. in telopodite arc length and 1.86 mm. in arc width), curved cephalomesiad at cingulum, then dorsad, then caudolaterad, then ventrad at tip; a strong tooth on cephalic side of postcingular portion of telopodite about midway of its length; tip subacuminate; cingulum located low on telopodite, precingular portion or telopodite much shorter than postcingular portion.

Color faded in specimens examined.

TYPE LOCALITY: Cumberland Mountains, Pennington Gap, Lee County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by H. G. Hubbard. No date given. Male holotype and male paratype in the U. S. National Museum.

DISCUSSION: *Brachoria dentata* is strikingly different from any of the species of the genus heretofore known. The cingulum of the gonopod is located low on the telopodite so that the precingular portion is much shorter than the postcingular portion. *Brachoria insolita* is the only other species of the genus that shows this characteristic. The presence of a well-defined tooth on the telopodite well back from the end is also a character found elsewhere in this genus only in *Brachoria insolita*. The two species resemble each other also in the prefemoral spine which is apparently either almost absent or rather weak.

It seems apparent on the basis of the characters mentioned that *dentata* and *insolita* are more closely related to each other than to any other species of the genus. Indeed, a case could be built for erecting a new genus to include them, but it seems wiser at present to retain them in *Brachoria*. Knowledge of the various genera of the Xystodesmidae is still very meager and the strong probability of future discovery of new and annectant forms makes a somewhat conservative course concerning genera the most advantageous. The cases of *Tucoria* and *Anfractogon* provide good examples illustrating the basis for this line of reasoning.

Brachoria electa Causey

FIGURE 2*g–i*

Brachoria electa Causey, Proc. Biol. Soc. Washington, vol. 68, pp. 25, 27, fig. 3, 1955.

DIAGNOSIS: Distinguished from all other species of the genus except *ochra, indianae, cedra,* and *separanda* by the small size and bulk of the gonopods and by their simple form. Differs from the four species mentioned in having a caudally directed twist in the distal portion of the telopodite.

DESCRIPTION: Length of holotype, not given; width, 9.6 mm.; length of other male specimens, 36–38 mm.; width 9 mm.; length of female, 41 mm.; width, 9 mm.

Resembles *B. ochra initialis* in all but the characteristics mentioned below.

Ends of paranota of collum not as narrowly rounded; paranotal swellings very weak; ridges on anterior edges of paranota not so strongly developed.

Paranota of 2d and all succeeding segments more rounded; caudolateral corners of 9th paranota only very slightly produced caudad or not at all; paranota of segments 17 and 18 not so sharply triangular.

Sternum between 4th legs with pair of small but distinct processes; sternum of 5th legs with pair of weak, indistinct processes; sternum of 6th legs with no processes.

Coxal armature well developed.

Gonopods small (about 1.74 mm. in telopodite arc length and 1.19 mm. in arc width); curved mesiad, then twisted abruptly caudad, then curving dorsad, tip subacuminate; cingulum located at point of strongest mesial curvature; precingular portion somewhat longer than postcingular portion. Preformal spine moderately strong. Cyphopods like those of *initialis*.

Color faded in all specimens but some evidence that pattern was either of trimaculate type or banded type.

Type locality: Tyrone, Anderson County, Ky.

Type specimen: In American Museum of Natural History.

New distribution record:

Kentucky: Mercer County: Kentucky River bluff, 1 mile northeast of Shakertown, May 1, 1954 (1 ♂, 1 ♀), Hubricht.

Discussion: This species resembles very closely *Brachoria ochra initialis*, the type of the genus. The two forms agree closely in general body form, differing only in the extent to which the caudolateral corners of the paranota are produced caudad. The male gonopods are strikingly similar in both size and form, the primary difference being the presence of a caudally directed twist just beyond the midpoint of the postcingular portion of the telepodite of the gonopod of *B. electa*. This twist is not present in *B. ochra initialis*.

The differences between *B. electa and B. ochra initialis* are so slight that it is possible that *B. electa* eventually will be shown to be a subspecies of *B. ochra*. The two forms are being left separate, however, until such time as further collecting reveals the true situation.

Brachoria eutypa eutypa Chamberlin

Figure 3*a–g*

Brachoria eutypa Chamberlin, Bull. Univ. Utah, biol. ser., vol. 5, No. 3, p. 4, fig. 4, 1939.

Diagnosis: Distinguished from all other species of the genus except *hansonia*, *plecta*, and *separanda* by the medium size, and slender, simple form of the gonopods. Differs from *hansonia* and *separanda* in that the extreme distal end of the telopodite of the gonopod is

always slightly hook-shaped while the telopodite in both *hansonia* and *separanda* narrows gradually to a pointed tip. Differs from *separanda* and *plecta* in that the portion of the telopodite just distal to the cingulum is not noticeably larger than the portion just proximal to the cingulum. Distinguished from *eutypa ethotela* by the absence of a swelling just proximal to the distal end of the telopodite.

DESCRIPTION: Length of holotype, 38 mm.; width, 9.8 mm.; length of other males, 37–44 mm.; width, 9–11 mm.; length of females, 43–46 mm.; width, 10.5–12.5 mm.

Collum ellipsoidal, edges gently curved, ends of paranota gently rounded; paranotal swellings extremely weak; ridges of anterior edges of paranota variable.

Paranotal swellings become increasingly more noticeable from segments 2 and 3 on, but never becoming very strong. Paranota of segment 9 and anterior segments squared at caudolateral corners; paranota of segments 10, 11, and 12 showing very slight caudad production.

Sternum of 3d pair of legs with very weak processes; processes on sternum of 4th legs barely noticeable; sternum of 5th legs with median groove but no processes; sternum of 6th legs smooth.

Coxal armature usually weak, rarely moderate.

Male gonopods of medium size (about 1.91–2.03 mm. in telopodite arc length and 1.8–2.02 mm. in arc width); simple; curved mesiad, then dorsad, then caudodorsad; extreme distal end bent to hook-like appearance; cingulum located at point on arc most remote from body; precingular portion but slightly longer than postcingular portion (in some specimens subequal). Prefemoral spine moderate.

Color dark brown above and on preanal scale; caudolateral portions of all paranota very light yellow, almost white; a median light spot on posterior margin of each tergite; collum with two median light spots, one on posterior margin and one on anterior margin; underparts tan; antennae dark brown, the last three articles darkest.

TYPE LOCALITY: Russellville, Hamblen County, Tenn.

TYPE SPECIMEN: In the private collection of R. V. Chamberlin.

NEW DISTRIBUTION RECORDS:

NORTH CAROLINA: Avery County: between Banner Elk and Newland, June 15, 1953 (1 ♂), Hoffman. TENNESSEE: Cumberland County: Crab Orchard Mountain, Crab Orchard Gap, 2 miles east of Crab Orchard, May 9, 1951 (1 ♂), Hubricht. Granger County: tulip tree woods, 6.8 miles south of Rutledge, May 19, 1956 (2 ♂, 2 ♀), Hoffman, Keeton, and Lund. Hamblen County: Russellville, June 1, 1952 (3 ♂, 2 ♀), Hoffman and P. C. Holt. Hawkins County: beechwoods, 4.3 miles northeast of Surgoinsville on Route 11 W, May 19, 1956 (2 ♂, 3 ♀), Hoffman, Keeton, and Lund. Jefferson County: 2.3 miles north of Dandridge (1 ♀) and 2 miles north of Jefferson City (2 ♂, 1 ♀), May 19, 1956, Hoffman, Keeton, and Lund. Sullivan County: Worley Cave Sink, 2.5 miles east of Bluff City, May 2, 1951 (7 ♂, 1 ♀), Hubricht. Washington County: oak woods, 3 miles east of Jonesboro, May 3, 1951 (3 ♂, 1 ♀), Hubricht.

***Brachoria eutypa ethotela* Chamberlin, new combination**

FIGURE 3*h–j*

Brachoria ethotela Chamberlin, Bull. Univ. Utah, biol. ser., vol. 6, no. 8, p. 5, fig. 13, 1942.

DIAGNOSIS: Distinguished from all other species of the genus except *hansonia*, *plecta*, and *separanda* by the medium size and slender, simple form of the gonopods. Differs from *hansonia* and *separanda* in that the distal end of the telopodite of the gonopod is somewhat swollen, with a hook-shaped end. Differs from *separanda* and *plecta* in that the portion of the telopodite just distal to the cingulum is not noticeably larger than the portion just proximal to the cingulum. Distinguished from *eutypa eutypa* by the presence of a swelling just proximal to the distal end of the telopodite.

DESCRIPTION: Length of holotype, not given; width, 9 mm.; length of other male specimens, 37–41 mm.; width, 8–10 mm.; length of female, 41 mm.; width, 9 mm.

Collum ellipsoidal, edges gently curved, ends of paranota broadly rounded; paranotal swellings extremely weak or absent; no ridges extending along cephalic edges of paranota.

Paranotal swellings either extremely weak or absent on segments 2 and 3, very slightly stronger on segment 4, never very strong on any segment. Paranota of segments 2–7 gently rounded; those of succeeding segments, including 9th, more abruptly rounded; paranota of segments 16, 17, and 18 not very sharply triangular.

Sterna of 3d and 4th pairs of legs with well-developed processes; sternum of 5th legs with pair of weak processes; sternum of 6th legs ridged in some specimens, smooth in others.

Armature of prefemora of postgenital legs not quite as strong as in *initialis*. Coxal armature of males weak to moderate.

Male gonopods of medium size (about 2.03 mm. in telopodite arc length and 2.12 mm. in arc width); simple; curved mesiad, then dorsad in continuous arc; extreme distal end bent to hook-like appearance; a noticeable swelling just proximal to distal end; cingulum located at point on arc just proximal to point most remote from body; precingular portion slightly longer than postcingular portion. Prefemoral spine moderate.

Color very dark brown above and on preanal scale; bright yellow on caudolateral portion of all paranota, including collum; a small median yellow spot on anterior margin of collum; distal half of last tergite yellow; underparts and legs light brown; antennae dark brown, last three joints darkest.

TYPE LOCALITY: Marion, Smyth County, Va.

TYPE SPECIMEN: In the private collection of R. V. Chamberlin.

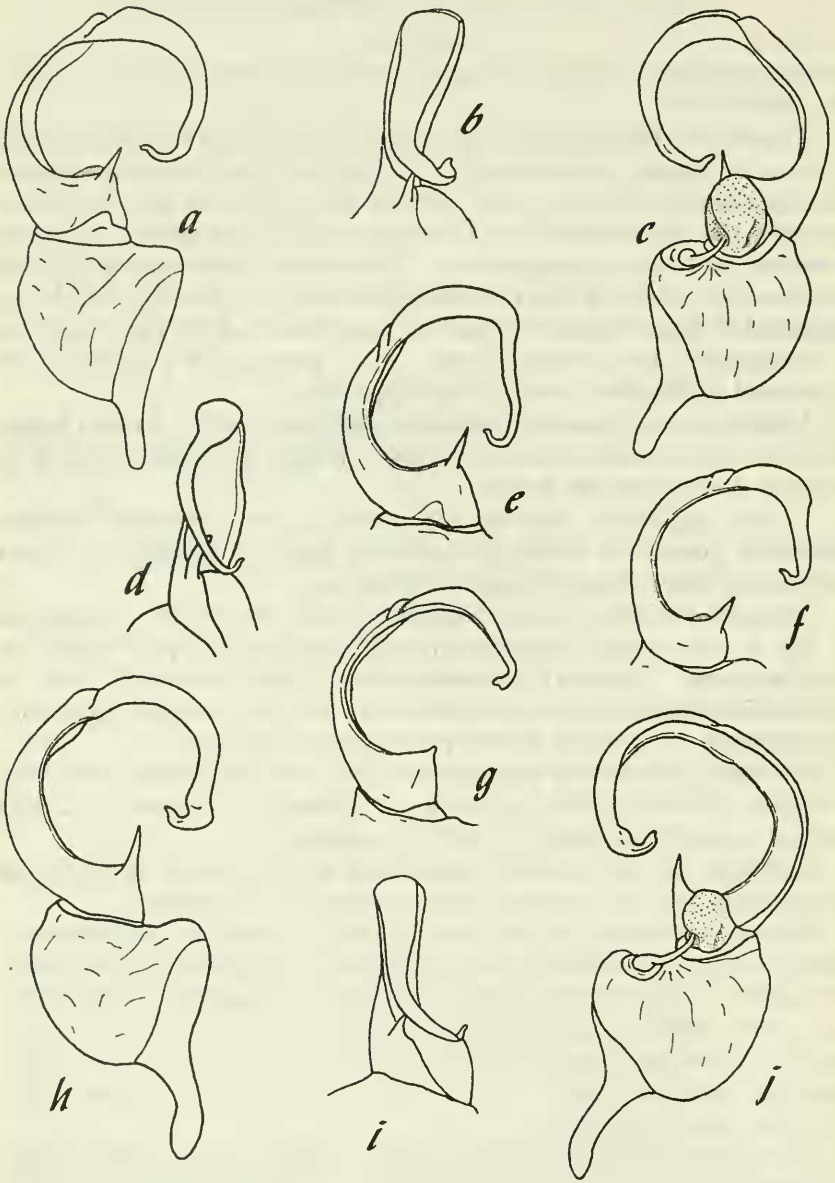

FIGURE 3.—Left male gonopods of subspecies of *Brachoria eutypa*. *a–c*, Topotype of *B. e. eutypa:* cephalic, mesial, and caudal views. *d, e*, *B. e. eutypa* from Cumberland County, Tenn.: mesial and cephalic views showing long, slender telopodite. *f*, *B. e. eutypa* from near Bluff City, Tenn.: cephalic view showing short telopodite. *g*, *B. e. eutypa* from Avery County, N. C.: cephalic view showing reduced prefemoral spine. *h–j*, *B. e. ethotela:* cephalic, mesial, and caudal views.

New distribution records:

Virginia: Grayson County: Mount Rogers, elevation 4,800 feet, Aug. 3, 1955 (1 ♂), Hoffman; same location, Aug. 20, 1955 (1 ♂), V. P. I. expedition. Washington County: Konnarock, Aug. 2, 1941 (1 ♂); Neals Farm near Damascus, Aug. 18, 1941 (1 ♂, 2 ♀), Dr. and Mrs. S. T. Brooks.

Discussion: This species brings to our attention one of the most interesting problems in diplopod taxonomy, that of subspeciation. For many years it has been customary to designate each new form as a full species. This has often been a justified procedure inasmuch as many of the forms concerned have been known from only a few specimens and ranges have been poorly understood.

More recently, however, systematic collecting has often revealed the presence of intermediate forms so that it is now known that what were formerly considered full species are actually geographical populations forming distribution series with intergrades occurring at the borders of the populations.

This phenomenon has been studied in several genera of the Xystodesmidae by Hoffman (1951) and he has considered that it represents subspeciation of a type comparable with that found in many vertebrate groups such as fish, amphibians, reptiles, etc.

Some workers have recently been rather strong in their denunciation of the subspecies concept. They maintain that the subspecies as now used has no reality and only tends to confuse understanding of variation and to add a needless multiplicity of names. It is my belief that this criticism goes too far. It is true that the subspecies concept must be used with caution and that it has often been misused. This does not mean, however, that the concept is invalid or should be abandoned. There are in biology many instances of continuous clines of variation and it seems obvious that attempts to arbitrarily delimit stages in these continua and call them subspecies are ill-advised and can only be misleading. The value of the subspecies category is apparent in those cases where the spatial isolation of the unit populations is more nearly complete.

It is my feeling that *Brachoria eutypa* illustrates a case where subspecies designation is not only appropriate but is the most adequate method of describing the facts as they are now known. In addition this species provides a good example of clinal variation.

Brachoria eutypa was described by Chamberlin from Hamblen County, Tenn., in 1939. In 1942, Chamberlin described *Brachoria ethotela* from Marian, Va. These two forms differed from each other in several particulars. The postcingular portion of the telopodite of the male gonopods is often considerably longer and somewhat thinner in *eutypa*. The distal end of the telopodite of *ethotela* is heavier and slightly more complex. In addition, *eutypa* has the tri-

maculate body color pattern while *ethotela* has the bimaculate pattern. These differences have seemed sufficient to maintain the two as separate species until the present time.

Recently, however, a series of specimens from the extreme northeastern part of Tennessee has been found to exhibit characters intermediate between *eutypa* and *ethotela*. These specimens are not only intermediate in the form of the male gonopods but show interesting variation in color pattern as well. Most of these specimens show the trimaculate pattern like *eutypa* but some few have the bimaculate pattern typical of *ethotela*. It seems obvious that the existence of these intermediate specimens in the area where the ranges of *eutypa* and *ethotela* join makes it necessary to regard the two as only subspecifically distinct.

Study of a number of collections of *eutypa eutypa* from various parts of Tennessee has shown that clinal variation is very evident within this subspecies. Indeed, I at first thought that at least two different subspecies were involved. Extensive collecting has shown, however, that the characters change gradually as one moves from northeastern Tennessee towards the west or southwest. The postcingular portion of the telopodite of the male gonopod becomes longer and more slender and the collum ridge becomes more and more evident. The latter character is of special interest inasmuch as it is constant within species in most instances.

An interesting specimen collected in Avery County, N. C., may represent another subspecies, but it is being considered an aberrant specimen of *eutypa eutypa* until such time as more collecting reveals the true situation. This specimen has the telopodite of the male gonopod of the typical *eutypa* form, but the usually moderately strong prefemoral spine is reduced to a small nub (fig. 3*g*). This is more variation than would normally be expected, but inasmuch as variation in this character, albeit to a lesser extent, is known in other species such as *B. insolita*, it seems insufficient for separate nomenclatorial distinction when only one specimen is known. The specimen shows the bimaculate color pattern which is not the typical pattern for *eutypa eutypa*.

It is necessary that attention be called to the distribution record for Burkes Garden in southwestern Virginia given by Hoffman (1949) for *ethotela*. These specimens actually represent a new species, *Brachoria hamata* (p. 30).

The specimens upon which the distribution records for *ethotela* in Kentucky given by Causey (1955) were based have been examined by the author. The clarifications provided by the present study make it possible to identify these specimens with more certainty.

Some of them are now assigned to *Brachoria indianae* and the others to the new species *Brachoria plecta.*

***Brachoria falcifera*, new species**

FIGURE 4*a–c*

DIAGNOSIS: Distinguished from all other species of the genus by the very thin form of the telopodite of the male gonopods and by the distinctive shape of the distal end of the telopodite.

DESCRIPTION: Length of male holotype, 40 mm.; width, 10 mm.; length of female, 35 mm.; width, 9 mm.

Collum ellipsoidal, ends of paranota gently rounded; paranotal swellings absent, only a very weak trace of ridges on anterior edges of paranota.

Paranotal swellings nearly absent from segments 2 and 3; slightly stronger on segment 4 and all succeeding segments but never very strong. Paranota of segments 2–10 broadly rounded with no evidence of being caudally produced on corners; paranota of segments 11–14 rather square.

Sterna of 3d, 4th, and 5th pairs of legs with well-defined processes. Sternum of 6th legs smooth.

Coxal armature moderate to strong.

Male gonopods of medium size (about 2.14 mm. in telopodite arc length and 1.68 mm. in arc width); of very slender form; simple; curved mesiad, then cephalomesiad, then cephalodorsad, then dorsolaterad in continuous arc; extreme distal end curving ventrocaudad; distal portion of telopodite distinctly sickle-shaped; cingulum located at point of strongest mesial curvature; precingular portion and postcingular portion subequal in length. Prefemoral spine moderate.

Color in life black, with caudolateral corners of paranota and caudal edges of tergites reddish pink; underparts whitish, legs becoming pink distally.

TYPE LOCALITY: Grimleysville, Buchanan County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by R. L. Hoffman and W. B. Newman, June 30, 1951. Male holotype and female allotype in the U. S. National Museum.

DISCUSSION: *Brachoria falcifera* is a very distinctive species. The unique shape and extremely thin form of the male gonopods are unlike any other species of the genus. Especially interesting is the fact that this species is at present known only from the type locality in Buchanan County, Va., which is also the county in which the two new species *hoffmani* and *laminata* were found. These two forms, however, have heavy, complicated male gonopods which apparently indicate that they are phylogenetically quite distant from *falcifera.*

Brachoria glendalea (Chamberlin)

FIGURE 4*d–f*

Fontaria glendalea Chamberlin, Psyche, vol. 25, pp. 123–124, 1918.
Brachoria glendalea, Chamberlin and Hoffman, U. S. Nat. Mus. Bull. 212, p. 24, 1958.

DIAGNOSIS: Distinguished from all other species in the genus by the small size, by the simple but broad flat form of the telopodite of the male gonopod, and by the fact that the arc is completed quite distant from the base of the telopodite.

DESCRIPTION: Length of male holotype, 39 mm.; width, 10 mm.; length of other male specimen, 36 mm.; width, 10 mm.

Collum ellipsoidal, edges gently curved, ends of paranota rounded; paranotal swellings extremely weak; moderately strong ridges extending from ends of paranota along their cephalic edges to points at level of their bases.

Paranotal swellings extremely weak on segment 2, much more evident on segment 3 and all succeeding segments. Paranota of midbody segments rather square, 9th and succeeding segments with the caudolateral corner produced caudad very slightly.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of very small, subconical processes; sterna of 5th and 6th legs smooth.

Coxal armature very weak.

Male gonopods of medium size (about 2.02 mm. in telopodite arc length and 1.13 mm. in arc width); curved mesiad, then dorsad, then laterad, entire arc being completed quite distant from base of telopodite; telopodite blade rather broad and flat, distal end tapering to a subacute point; cingulum located just distal of point of initial mesial curvature; precingular portion longer than postcingular portion. Prefemoral spine moderate.

Color dark brown above with paranota entirely yellow except for a very small bit of mesocephalic portion; no median light spot on collum; antennae dark brown; underparts and legs very light brown.

TYPE LOCALITY: Glendale Hills, Nashville, Davidson County, Tenn.

TYPE SPECIMEN: In Museum of Comparative Zoology, Cambridge, Mass.

NEW DISTRIBUTION RECORDS:

TENNESSEE: Hickman County: Duck River bluff north of Centerville, Sept. 24, 1955 (1♂), Hubricht. Perry County: near Campbell Cave, 2.5 miles east of Linden, June 16, 1957 (1♂), Hubricht.

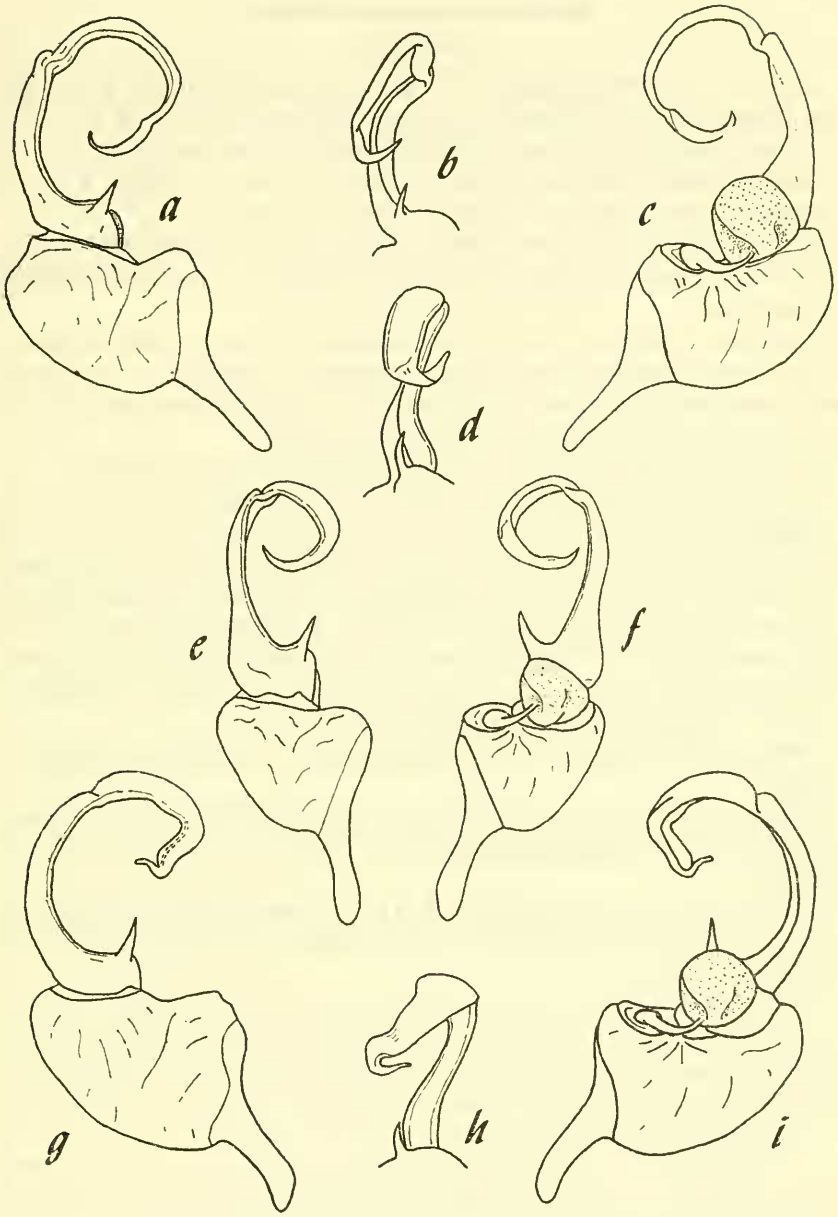

FIGURE 4.—Left male gonopods of species of *Brachoria*. *a–c*, *B. falcifera:* cephalic, mesial, and caudal views. *d–f*, *B. glendalea:* mesial, cephalic, and caudal views. *g–i*, *B. hamata:* cephalic, mesial, and caudal views.

Brachoria hamata, new species

FIGURE 4*g–i*

DIAGNOSIS: Distinguished from all other species of the genus by the strongly developed hook on the end of the telopodite of the male gonopod, the distal portion of which is abruptly reduced in size.

DESCRIPTION: Length of male holotype, 38 mm.; width, 9 mm.; length of female allotype, 39.5 mm.; width, 11 mm.

Collum ellipsoidal, edges gently curved, ends of paranota broadly rounded; paranotal swellings absent; no ridges on cephalic margins of paranota.

Paranotal swellings absent from segments 2 and 3, weakly evident on segment 4 and all succeeding segments. Paranota of midbody segments, including those of 9th segment, rounded; paranota of 17th and 18th segments not very sharply triangular.

Sterna of 3d–6th pairs of legs with well-developed processes.

Coxal armature weak in male, moderately strong in female.

Male gonopods of medium size (about 2.03 mm. in telopodite arc length and 1.8 mm. in arc width); curved gradually mesiad, then mesiodorsad, then abruptly laterodorsad, tip bent abruptly laterooventrad; distal tip of telopodite abruptly much smaller than portion just proximal to it; cingulum located just proximal to point on arc most remote from body; precingular portion longer than postcingular portion. Prefemoral spine moderate.

Color, dorsally black, caudolateral corners of paranota bright orange in life.

TYPE LOCALITY: Beartown Mountain, about 4,600 feet in elevation, Burkes Garden, Tazewell County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by R. L. Hoffman and H. I. Kleinpeter, June 29, 1947. Male holotype and female allotype in the U. S. National Museum.

DISCUSSION: The new species *Brachoria hamata* is based upon a group of specimens from Burkes Garden, Va., first reported by Hoffman (1949) as *Brachoria ethotela*. Careful examination has convinced me that they are actually quite distinct from *ethotela*, and they are here given full specific recognition.

This species is of considerable interest inasmuch as it has so far been found only in the unusual Burkes Garden area and is thus another example of the very distinctive fauna of that locality.

Burkes Garden is a large anticlinal, limestone valley on the west side of Clinch Mountain. The almost completely enclosed condition of the valley and its high elevation have resulted in most unusual ecological conditions. Distribution records for the area have often

been found to be very different from those in the surrounding areas. Hoffman and Kleinpeter (1949) and Hoffman (1955) have studied the herpetological fauna of Burkes Garden in recent years and some of their findings are very striking. It is not unexpected, then, that the diplopod fauna of the region should also be distinctive. More extensive collecting will doubtless reveal many more facts of interest to students of millipeds.

The specific name refers to the hooklike development of the male gonopods.

Brachoria hansonia Causey

FIGURE 5*a–c*

Brachoria hansonia Causey, Ent. News, vol. 61, pp. 6, 7, fig. 1, 1950.

DIAGNOSIS: Distinguished from all other species of the genus except *separanda* and *hubrichti* by the completely simple form and large size of the telopodite of the male gonopods. Differs from *separanda* in not having an enlargement of the telopodite just distal to the cingulum and in the smooth curve of the telopodite arc with no abrupt bends. Differs from *hubrichti* in the more slender form of the telopodite and in the acuminate distal end.

DESCRIPTION: Length of holotype, 49 mm.; width, 11 mm.; length of females, 51 mm.; width, 11 mm.

Midbody paranota, including those of 9th segment, rather square. Paranota of segments 17 and 18 not very sharply triangular.

Sternum of 3d pair of legs with the usual processes; sterna of 4th and 5th legs with well-developed processes; sternum of 6th legs smooth.

Male gonopods rather large (about 2.6 mm. in telopodite arc length and 1.9 mm. in arc width); completely simple; curving mesiad, then dorsad, the tip laterad, all in a continuous smooth arc; cingulum located just distal to point of initial mesial curvature; precingular and postcingular portions subequal. Prefemoral spine moderate.

Color faded.

TYPE LOCALITY: Kentucky Ridge State Forest, Pineville, Bell County, Ky. Known only from the type locality.

TYPE SPECIMEN: In Academy of Natural Sciences of Philadelphia.

Brachoria hoffmani, new species

FIGURE 5*d–f*

DIAGNOSIS: Distinguished from all other species of the genus except *laminata* by the presence of a thin terminal plate on the telopodite of the male gonopods. Differs from *laminata* in the much longer postcingular portion of the telopodite, and the shape and complexity of the terminal plate.

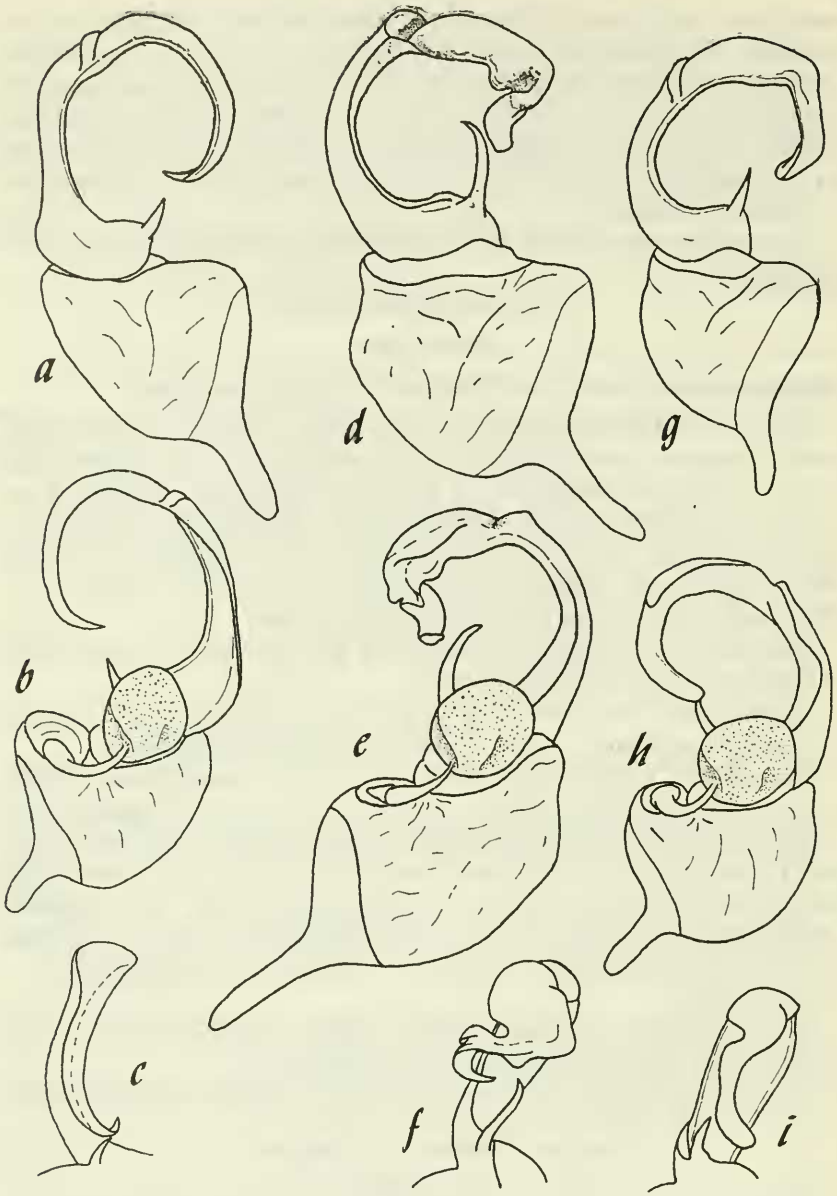

FIGURE 5.—Cephalic, caudal, and mesial views of left male gonopods of species of *Brachoria*. *a–c*, *B. hansonia*, holotype; *d–f*, *B. hoffmani*; *g–i*, *B. hubrichti*.

DESCRIPTION: Length of male holotype, 43 mm.; width, 10.5 mm.; length of male paratype, 41.5 mm.; width, 10 mm.; length of female, 47 mm.; width, 11.5 mm.

Collum ellipsoidal, ends of paranota narrowly rounded; paranotal swellings weak; strong ridges along cephalic edges of paranota.

Paranotal swellings present but weak on segments 2 and 3, stronger on succeeding segments. Paranota of midbody segments, including 9th, rather square. Paranota of segments 16–18 bluntly triangular.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of small processes; sterna of 5th and 6th legs without processes.

Coxal armature strong.

Male gonopods large (about 2.36 mm. in telopodite arc length and 2.22 mm. in arc width); curved cephalomesiad, then mesiad in a smooth arc, beyond this point bent abruptly cephalolaterad, terminal plate directed laterodorsad for a very short distance, then directly dorsad, its distal end bent abruptly caudad; postcingular portion of telopodite very complex and heavy, inner side with several prominent ridges, a thin terminal plate on distal end, this plate longer than broad; cingulum very prominent, located at point on arc most remote from body; precingular portion of telopodite longer than postcingular portion. Prefemoral spine very long.

Color somewhat faded but indicates dark brown dorsum with light paranota and a light band across caudal border of each tergite.

TYPE LOCALITY: Vansant, Buchanan County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by R. L. Hoffman and W. B. Newman, July 2, 1951. Male holotype, male paratype, and female allotype in the U. S. National Museum.

DISCUSSION: *Brachoria hoffmani* is a species with exceedingly complicated gonopods. The postcingular portion of the telopodite is rather *Tucoria*-like except in its length while in other respects, particularly the very strongly developed prefemoral spine, the gonopod resembles the old conception of *Brachoria*.

I take great pleasure in naming this species for my very good friend Richard L. Hoffman whose constant help and guidance have made this paper possible.

***Brachoria hubrichti*, new species**

FIGURE 5*g–i*

DIAGNOSIS: Distinguished from all other species of the genus except *hansonia* and *separanda* by the size and completely simple form of the

telopodite of the male gonopod. Differs from *hansonia* and *separanda* in the considerably stouter nature of the telopodite.

DESCRIPTION: Length of male holotype, 41 mm.; width, 9.5 mm.; length of female allotype, 44 mm.; width, 11 mm.; length of other male, 46 mm.; width, 11 mm.

Collum subellipsoidal, closely resembling *initialis*, the posterior edges of paranota curved more noticeably forward than in most species of the genus, ends of paranota narrowly rounded, caudolateral corners curved rather abruptly; paranotal swellings present but weak; strong ridges along cephalic margins of paranota.

Paranotal swellings distinct on segment 2 and all succeeding segments. Segment 2 and all succeeding midbody segments, including 9th, rather square; paranota of segments 16–18 bluntly triangular.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with very weak traces of processes; sterna of 5th and 6th legs smooth.

Coxal armature moderate.

Male gonopods of medium size (about 2.1 mm. in telopodite arc length and 1.9 mm. in arc width); completely simple in form; curved gradually mesiad, then more abruptly dorsad, end curving somewhat laterodorsad; half of postcingular portion between cingulum and abrupt bend much broader than half beyond bend; cingulum located at point on arc about midway between point of initial mesial curvature and abrupt bend dorsad; precingular portion of telopodite and postcingular portion subequal. Prefemoral spine moderate.

Color: Dorsum dark brown, paranota red, underparts tan; last two joints of legs pink.

TYPE LOCALITY: McMinnville, Warren County, Tenn.

TYPE SPECIMENS: Collected by Leslie Hubricht, May 21, 1951. Male holotype and female allotype in the U. S. National Museum.

OTHER DISTRIBUTION RECORDS:

TENNESSEE: Hamilton County: Signal Mountain, July 22, 1956 (1 ♂), Hoffman. Marion County: west fork of Pryor Cove, 2 miles northeast of Jasper, June 27, 1957 (2 ♂, 1 ♀), Hubricht.

DISCUSSION: I take great pleasure in naming this species for Mr. Leslie Hubricht whose extensive collecting of millipeds has played an important role in the extension of our knowledge of the diplopod fauna of North America. Without the specimens of *Brachoria* collected by Mr. Hubricht, the present study would have been impossible.

***Brachoria indianae* (Bollman)**

FIGURE 6*a–c*

Fontaria indianae Bollman, Proc. U. S. Nat. Mus., vol. 11, pp. 406–407, 1888.
Brachoria indianae, Chamberlin and Hoffman, U. S. Nat. Mus. Bull. 212, p. 24, 1958.

DIAGNOSIS: Distinguished from all other species in the genus by the combination of the small size of the gonopods and the very short, rather broad postcingular portion of the telopodite.

DESCRIPTION: Length of male lectotype, 31 mm.; width, 7.5 mm.; length of male paratype, 35 mm.; width, 9 mm.; length of female paratypes, 38–39 mm.; width, 8–9 mm.; length of other male specimens, 32–38 mm.; width, 7–8.3.

Collum subellipsoidal, ends of paranota narrowly rounded; paranotal swellings present; ridges along anterior margins of paranota.

Paranotal swellings evident on all segments. Paranota of segments 2–7 rounded, those of 8–11 more square (in some of Bollman's female specimens the caudolateral corners of the paranota of the 9th segment are slightly produced caudad).

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with very weak indications of processes; sterna of 5th and 6th legs without processes but a groove through center of sternum of 5th legs.

Coxal armature moderately strong.

Male gonopods small (about 1.6 mm. in telopodite arc length and 1.0 mm. in arc width); simple, curved gradually mesiad, then abruptly cephalodorsad; postcingular portion of telopodite short, rather broad for most of its length, narrowing towards distal end. Prefemoral spine rather large (bifid in lectotype only).

Color: Dorsum dark brown, paranota yellow, tergites sometimes narrowly margined posteriorly with yellow.

TYPE SPECIMENS: Bollman's original description mentioned three males and seven females. No holotype was designated. Two of the females and parts of the three males are in the U. S. National Museum. Inasmuch as Bollman mentioned most explicitly the specimen with bifid prefemoral spines, and since this specimen is in relatively good condition, the author hereby designates it as the lectotype specimen.

TYPE LOCALITY: Bollman mentioned both Brookville and Hagerstown, Ind. Chamberlin and Hoffman (1958) restricted the type locality to Brookville. This is the locality at which all the males were collected. Inasmuch as females are very difficult to identify, the Hagerstown record is even a doubtful one for the species.

NEW DISTRIBUTION RECORDS:

INDIANA: Clark County: upland oak woods, 1.5 miles southeast of Solon, Apr. 28, 1956 (1 ♂), Hubricht. KENTUCKY: Fayette County: Lexington, Oct. 1, 1894 (1 ♂), H. Garman; Richmond Road at Kentucky River, May 30, 1892 (1 ♂), H. Garman.

DISCUSSION: Bollman's description of this species mentioned the bifid nature of the basal or prefemoral spine. I have examined all three of Bollman's male type specimens. Only one shows this bifid

condition, the other two being normal. None of the other specimens examined have bifid spines. It is therefore assumed that the bifid condition is an abnormality and not typical of the species (the fact that in the one specimen both right and left gonopods show exactly the same bifid condition makes it improbable that the condition is due to the ends of the spines having been broken).

Brachoria insolita, new species

FIGURE 6*d–f*

DIAGNOSIS: Distinguished from all other species of the genus except *dentata* by the position of the cingulum on the telopodite of the male gonopods. Differs from all species of the genus except *mendota* in that the telopodite arc is primarily in a plane oblique to the longitudinal axis of the body.

DESCRIPTION: Length of male holotype, 41 mm.; width, 9 mm.: length of other male specimens, 38–46 mm.; width, 9–10.5 mm.

Collum subellipsoidal, curvature of edges somewhat irregular, ends of paranota rounded; paranotal swellings absent; very weak ridges along cephalic margins of paranota.

Paranotal swellings absent from 2d segment, weak on 3d segment, somewhat stronger on succeeding segments. Paranota of 2d segment and all succeeding midbody segments broadly rounded. Caudolateral corners of posterior segments, including 17th and 18th, broadly rounded.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of processes; sternum of 5th legs sometimes with pair of weak processes, sometimes without; sternum of 6th legs usually without processes, occasionally with a pair of very weak ones.

Coxal armature usually moderate, sometimes very weak.

Male gonopods of medium size (about 1.86 mm. in telopodite arc length and 1.8 mm. in arc width); curved gradually ventromesiad, then abruptly dorsocephalad, then abruptly laterad; a tooth on caudal side of telopodite just proximal to first abrupt bend; part of postcingular portion of telopodite distal to first abrupt bend much slimmer than part proximal to bend; cingulum located at point of initial mesial curvature near base of telopodite; precingular portion of telopodite much shorter than postcingular portion. Prefemoral spine very weak, sometimes absent.

Color: Dark brown above; light (probably yellow) on paranota except on cephalomesial corners; a large light median spot on caudal margin of all tergites including collum; collum with a large light median spot on cephalic margin; underparts straw-colored.

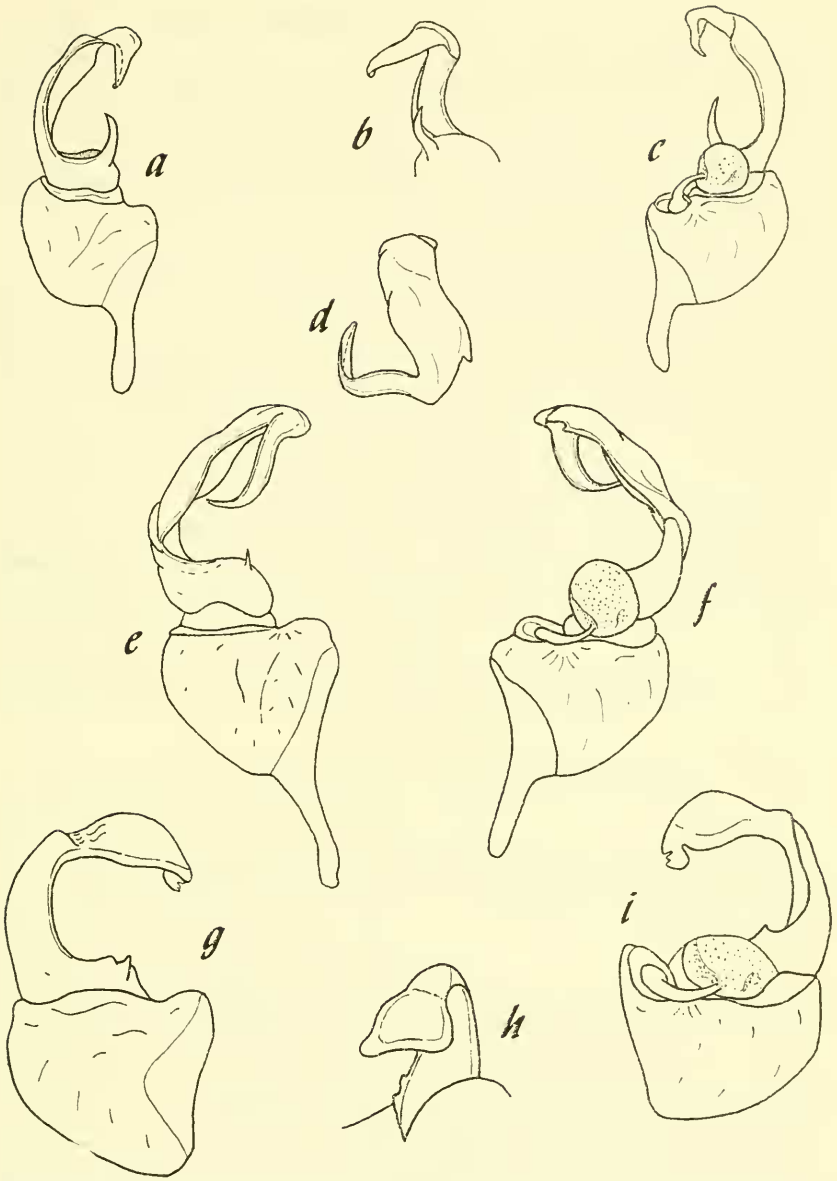

FIGURE 6.—Left male gonopods of species of *Brachoria*. *a–c*, *B. indianae:* cephalic, mesial, and caudal views of lectotype. *d–f*, *B. insolita:* ventral, cephalic, and caudal views. *g–i*, *B. kentuckiana:* cephalic, mesial, and caudal views of holotype.

TYPE LOCALITY: High Knob, Cumberland Gap, Wise County, Va. Known only from the type locality.

TYPE SPECIMENS: 13 males and one female collected by Leslie Hubricht, June 17, 1950. Male holotype, three male paratypes, and female allotype in the U. S. National Museum. Male paratype in the Chicago Natural History Museum. Four male paratypes in collection of Mr. R. L. Hoffman. Four male paratypes in the author's personal collection.

DISCUSSION: *Brachoria insolita* provides a good demonstration of the variability that can be expected in the prefemoral spine of the gonopod when it is typically rather weak. The drawing (fig. 6*e*) of the gonopods of this species shows a weak spine which is about average size for *insolita*. Of the 13 males examined by the author, most varied but little from this average size. Several, however, were slightly longer, and one showed no trace of a spine. Species with larger, heavier spines do not show this much variation.

The present species is unusual in the genus in that the telopodite arc is primarily in a plane oblique to the longitudinal axis of the body rather than in a plane perpendicular to the body as in most other species. For this reason no mesial view of the telopodite is given among the drawings of the gonopods; a ventral view is given instead. The new species *mendota* is the only other form in the genus with the gonopods showing this type of positioning.

***Brachoria kentuckiana* (Causey), new combination**

FIGURE 6*g–i*

Fontaria kentuckiana Causey, Ent. News, vol. 53, p. 167, figs. 3, 4, 1942.
Cleptoria kentuckiana Causey, Ent. News, vol. 54, p. 264, 1943.
Tucoria kentuckiana, Chamberlin, Bull. Univ. Utah, biol. ser., vol. 8, No. 2, p. 17, 1943.

DIAGNOSIS: Distinguished from all other species of the genus by the presence of a prominent pectinate solenomerite on the distal end of the telopodite of the male gonopod.

DESCRIPTION: Length of male holotype, 47.5 mm.; width, 11.7 mm.; length of female allotype, 52 mm.; width, 12.4 mm.

Collum with moderate anterior ridge.

Paranota of first few segments square; paranota of 9th segment with caudolateral corners produced very weakly caudad; paranota of more posterior segments more strongly produced.

Sternum of 3d pair of legs with usual processes; sterna of 4th and 5th legs each with a pair of processes; sternum of 6th legs with only weak trace of processes.

Coxal armature weak.

Male gonopods of medium size (about 1.8 mm. in telopodite arc length and 1.8 mm. in arc width); curved anteriomesiad; distal end of telopodite bearing a well-developed, dorsally directed, pectinate solenomerite; postcingular portion of telopodite very short, thickened; precingular portion much longer than postcingular portion. Prefemoral spine reduced to a small nub.

Color according to Causey: "the dorsum is shining dark brown; head and antennae brown; ends of collum, posterior angles of keels, roughly triangular areas on tergites or borders of tergites and collum red-orange; distal half of legs red-orange; underparts and proximal half of legs pale yellow. In alcohol dorsum fades to brown and keels and legs to yellow."

Type locality: Cumberland Falls State Park, Cumberland County, Ky. Known only from the type locality.

Type specimen: In Academy of Natural Sciences of Philadelphia.

Discussion: *B. kentuckiana* resembles both *calceata* and *laminata* in some respects and it is possible that more extensive collecting will reveal that the three are only subspecifically distinct.

In the drawings of the gonopods (fig. 6) no coxal apodeme is shown as this has been broken off the type specimen.

Brachoria laminata, new species

Figure 7*a–c*

Diagnosis: Distinguished from all other species of the genus except *hoffmani* by the presence of a thin terminal plate on the telopodite of the male gonopod (*calceata* shows much the same shaped distal end of the telopodite but the analogous structure is not plate-like and is not as distinct from the main portion of the telopodite). Differs from *hoffmani* in that the postcingular portion of the telopodite is very short, and in the shape of the terminal plate.

Description: Length of male holotype, 46 mm.; width, 11 mm.; length of male paratype, 42 mm.; width, 10.5 mm.; length of female allotype, 48 mm.; width, 11.5 mm.

Cephalic edge of collum irregular in its curvature, curving gently laterocaudad from midpoint to base of paranota, then swinging slightly forward, then more laterocaudad in a gentle arc; paranotal swellings absent; weak but noticeable ridges on cephalic margins of paranota; ends of paranota rounded.

Paranotal swellings absent from 2d segment, weakly present on 3d and succeeding segments. Paranota of midbody segments, including 9th, square; paranota of segments 16–18 bluntly triangular.

Sternum of 3d pair of legs with usual processes; sterna of 4th and 5th legs each with pair of processes; sternum of 6th legs smooth.

Coxal armature strong.

Male gonopods of medium size (about 1.97 mm. in telopodite arc length and 1.9 mm. in arc width); curving dorsomesiad, then dorsocephalad in a continuous arc, terminal plate directed almost directly laterad; a large thin terminal plate on distal end of telopodite, plate with a small, subterminal, toothed solenomerite; precingular portion of telopodite much longer than postcingular portion. Prefemoral spine moderately long, heavy.

Color somewhat faded, holotype indicates a trimaculate pattern, paratype indicates a bimaculate pattern, and allotype indicates a banded pattern. Whether this degree of color variation is typical is unknown.

TYPE LOCALITY: 3 miles southwest of Vansant, Buchanan County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by R. L. Hoffman and W. B. Newman, July 1, 1951. Male holotype, male paratype, and female allotype in the U. S. National Museum.

DISCUSSION: *Brachoria laminata* is another new species which fits into the group connecting *Brachoria* and *Tucoria*. The distal portion of the telopodite is rather *Tucoria*-like but the prefemoral spine is large and strong.

This species resembles *calceata* in many respects, while *calceata* in turn resembles *kentuckiana*. It is possible that the three are only subspecifically distinct. It seems best to keep them separate at present, however, inasmuch as so little is known of their ranges and no intergrades have as yet been found.

The name refers to the terminal plate of the telopodite of the male gonopod.

***Brachoria ligula*, new species**

FIGURE 7*d–f*

DIAGNOSIS: Distinguished from all other species of the genus by the rather broad flat form of the telopodite of the gonopod and the shape of the solenomerite.

DESCRIPTION: Length of male holotype, 41 mm.; width, 10.5 mm.; length of male paratype, 40 mm.; width, 10.5 mm.; length of female allotype, 45 mm.; width, 11 mm.

Collum shape very much like that described for *laminata;* no paranotal swellings present; strong ridges along proximal portions of cephalic margins of paranota; ends of paranota rounded.

Paranotal swellings absent from 2d segment of holotype, present in paratype and allotype, present on succeeding segments in all specimens. Paranota of 2d segment and all succeeding midbody segments, including the 9th, rounded.

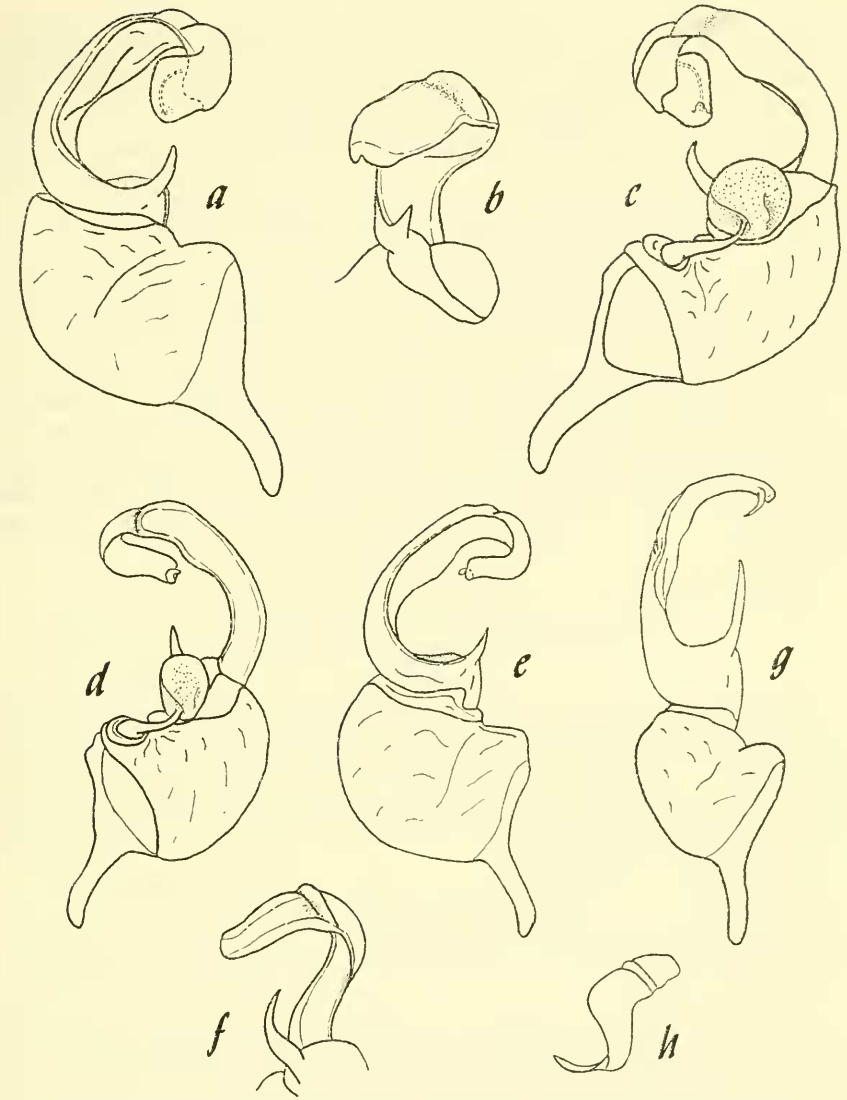

FIGURE 7.—Left male gonopods of species of *Brachoria*. *a–c*, *B. laminata:* cephalic, mesial, and caudal views. *d–f*, *B. ligula:* caudal, cephalic, and mesial views. *g*, *h*, *B. mendota:* cephalic and ventral views.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of small processes; sternum of 5th legs with no trace of processes in holotype, low mounds in paratype; sternum of 6th legs with no processes.

Coxal armature well developed.

Male gonopods of medium size (about 1.9 mm. in telopodite arc length and 1.5 mm. in arc width); broad, telopodite sigmoidally curved mesiad, then cephalad, then ventrolaterad and slightly caudad in a continuous arc; a prominent tongue-like solenomerite on distal end of telopodite; precingular portion of telopodite much longer than postcingular portion.

Color faded but indicates possibility of a trimaculate pattern.

TYPE LOCALITY: 1.3 miles east of Premier, McDowell County, W. Va. Known only from the type locality.

TYPE SPECIMENS: Collected by Leslie Hubricht, June 28, 1950. Male holotype, male paratype, and female allotype in the U. S. National Museum.

DISCUSSION: *Brachoria ligula* is another new species with gonopods intermediate in form between those formerly thought typical of *Brachoria* and *Tucoria*. The general form and lack of complexity of the telopodite and the development of the prefemoral spine are all more like *Brachoria*, but the bulk of the gonopods approaches that of *Tucoria*.

The name refers to the tongue-like solenomerite.

Brachoria mendota, new species

FIGURE 7*g,h*

DIAGNOSIS: Distinguished from all other species of the genus except *insolita* by the fact that the distal part of the arc of the gonopods is in a plane primarily parallel to the body. Differs from *insolita* in the location of the cingulum and in the absence of a tooth on the distal part of the telopodite.

DESCRIPTION: Length of male holotype, 38 mm.; width, 8 mm.; length of male paratype, 34 mm.; width, 8 mm.

Collum subellipsoidal, ends smoothly rounded; paranotal swellings and ridges absent.

Paranotal swellings absent on segments 2 and 3, very weak on segment 4, becoming slightly stronger on more posterior segments but never strong. Caudolateral corners of all paranota rounded.

Sternum of 3d pair of legs with median longitudinal groove; sternum of 4th legs with pair of small processes; sterna of 5th and 6th legs smooth.

Coxal armature of anterior and midbody segments weak, stronger on posterior segments.

Male gonopods long (about 2.22 mm. in telopodite arc length) but the telopodite arc not very wide (about 1.06 mm.); directed almost straight ventrad, then curving smoothly cephalomesiad, then more abruptly mesiad, then rather abruptly laterocephalad; portion of telopodite distal to last bend more slender than more proximal por-

tions, this distal portion somewhat twisted; postcingular portion of telopodite slightly longer than precingular portion. Prefemoral spine large.

Color of specimens faded, pattern apparently of bimaculate type.

Type locality: Mendota, Washington County, Va. Known only from the type locality.

Type specimens: Collected by Dr. and Mrs. S. T. Brooks, July 30, 1941. Male holotype in the U. S. National Museum. Male paratype retained in the author's collection.

Discussion: The form of the male gonopods in this species is so distinctive that I can detect no evidence of close relationships with any other known species of the genus.

In the illustrations of the gonopod of this species no caudal view is given inasmuch as it would show nothing not already shown in the cephalic view. In addition, a ventral view of the distal portion of the telopodite is substituted for a mesial view.

***Brachoria plecta*, new species**

Figure 8*a–c*

Diagnosis: Distinguished from all other species of the genus except *separanda* and *calcaria* by the enlarged portion of the telopodite of the male gonopod just distal to the cingulum. Differs from *separanda* in the size of the gonopod, the absence of a prefemoral spine on the gonopod, and the twisted and hooked shape of the telopodite distal to the enlarged portion. Differs from *calcaria* in all these characters and also in lacking teeth on the precingular portion of the telopodite.

Description: Length of male holotype, 36 mm.; width, 10 mm.; length of male paratype, 40 mm.; width, 9 mm.

Collum ellipsoidal, ends of paranota broadly rounded; paranotal swellings well defined in holotype, absent in paratype; ridges present along cephalic edges of paranota.

Paranotal swellings well defined on segment 2 and all succeeding segments in holotype; absent on 2, weak on 3, well-defined on 4 and all succeeding segments in paratype. Paranota of segments 2–6 round, those of segments 7–14 rather square; paranota of last few segments bluntly triangular.

Sternum of 3d pair of legs with usual processes; sterna of 4th and 5th legs with very small mounds; sternum of 6th legs with mounds only barely noticeable.

Coxal armature moderate.

Male gonopods of medium size (about 1.94 mm. in telopodite arc length and 1.56 mm. in arc width); curving mesiad, then cephalodorsad, then laterad, then hooked caudad; portion of telopodite just

distal to cingulum enlarged, becoming smaller again at a point about midway of length of postcingular portion; distal half of postcingular portion twisted so that erstwhile outer surface becomes caudal surface and inner surface becomes cephalic surface; end of telopodite not very acute. Precingular portion of telopodite longer than postcingular portion. Prefemoral spine absent.

Color of all specimens at hand faded.

TYPE LOCALITY: Natural Bridge, Powell County, Ky. Known only from the type locality.

TYPE SPECIMENS: Collected by H. Garman. Male holotype collected Oct. 21, 1911; male paratype, May 5, 1895. Both specimens were sent to Dr. Nell B. Causey of the University of Arkansas, who placed the holotype in the American Museum of Natural History and the paratype in the U. S. National Museum.

DISCUSSION: Although this species resembles *separanda* in having the proximal part of the postcingular portion of the telopodite of the gonopod enlarged, the resemblance seems to end there and it is felt that this does not indicate any close relationship.

This is one of the few known forms of *Brachoria* where the prefemoral spine seems to be typically entirely absent.

Study of these specimens was made possible by the cooperation of Dr. Causey, who loaned them to me.

The name refers to the twisted distal portion of the telopodite of the male gonopod.

Brachoria separanda Chamberlin

FIGURE 8*g–i*

Brachoria separanda Chamberlin, Proc. Acad. Nat. Sci. Philadelphia, vol. 99, p. 28, fig. 10, 1947.

DIAGNOSIS: Distinguished from all other species of the genus except *hansonia, ochra, cedra, hubrichti,* and *calcaria* by the completely simple form of the telopodite of the male gonopod. Differs from *hansonia* in having an enlargement of the telopodite just distal to the cingulum and in having two rather abrupt bends in the telopodite. Differs from *ochra* and *cedra* in the first of the two characters mentioned. Differs from *hubrichti* in the more slender and acuminate form of the telopodite. Resembles *calcaria* but lacks teeth on the precingular portion of the telopodite and the telopodite is more slender.

DESCRIPTION: Length of male holotype, 32 mm.; width, 6.5 mm.; length of other males, 34–38 mm.; width, 8–9 mm.

Collum ellipsoidal, edges gently curved, ends of paranota broadly rounded; paranotal swellings usually absent; ridges on cephalic margins of paranota usually absent.

Paranotal swellings usually absent from 2d segment, weakly present on 3d segment and all succeeding segments. Segment 2 and all succeeding midbody segments with paranota usually broadly rounded.

Sternum of 3d legs with usual processes; sternum of 4th legs with a pair of small processes, sternum of 5th legs usually smooth; sternum of 6th legs smooth.

Coxal armature usually moderate.

Gonopod aperture normal. Male gonopods variable in size, from about 1.6 to 2.2 mm. in telopodite arc length and 1.3 to 1.5 mm. in arc width; simple, distally subacuminate; curving mesiad, then abruptly dorsad, then abruptly laterad; cingulum large and conspicuous; precingular and postcingular portions of telopodite subequal. Prefemoral spine moderate.

Color: Dark brown above, paranota and last tergite lemon yellow, a median red spot on posterior margin of all tergites including collum, a median yellow spot on anterior margin of collum, underparts tan, distal joints of legs light pink.

Type locality: Jennings, Garrett County, Md.

Type specimen: In Academy of Natural Sciences of Philadelphia.

New distribution records:

West Virginia: Preston County: ravine, 1.8 miles east of Erwin, June 15, 1956 (1 ♂), Hubricht. Tucker County: 6 miles south of Parsons, Oct. 1, 1938 (1 ♂, 1 ♀), G. K. MacMillan. Webster County: wooded hillside, 1 mile east of Three Forks of William's River, May 28, 1952 (2 ♂), Hubricht.

Discussion: In the U. S. National Museum there is a specimen without a collection label that has gonopods very similar to the form typical of *Brachoria separanda*. This specimen differs, however, in many characters from all other known specimens of *separanda*. The distal portion of the telopodite of this specimen is extremely slender. Ridges are present on the anterior margins of the paranota of the collum; these are absent in typical *separanda*. Paranotal swellings are present on the collum and 2d segment while they are absent in these locations in *separanda*. The 9th paranota are somewhat caudally produced at the caudolateral corners while the paranota of *separanda* are broadly rounded. The coxal armature is very weak while *separanda* usually has moderate coxal armature. Weak processes are present on the sternum of the 5th legs while they are absent in typical *separanda*. Just what designation this specimen should receive, particularly in view of no collection data, is uncertain. For the moment it is considered an atypical specimen of *separanda*.

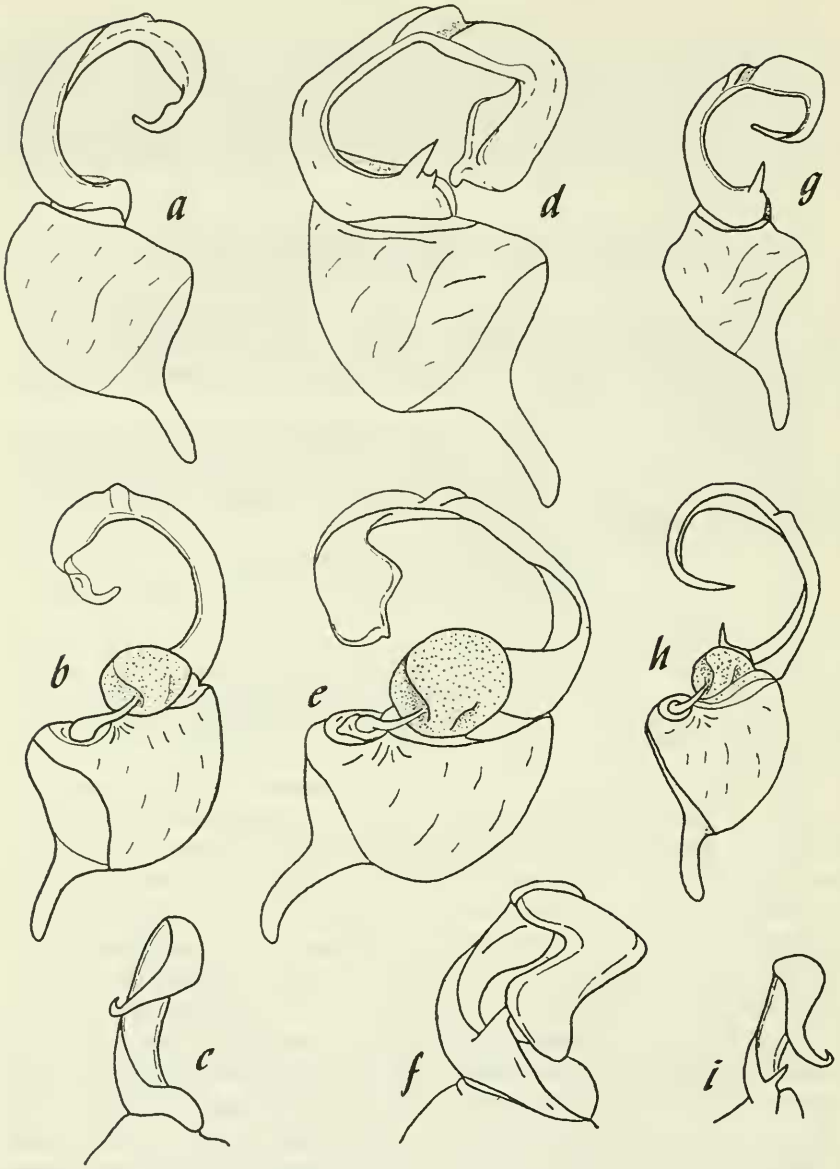

FIGURE 8.—Left male gonopods of species of *Brachoria*. *a–c*, *B. plecta:* cephalic, caudal, and mesial views. *d–f*, *B. splendida:* cephalic, caudal, and mesial views. *g–i*, *B. separanda: g*, cephalic view of holotype; *h*, caudal view of specimen from Webster County, W. Va., showing slightly larger gonopods; *i*, mesial view of holotype.

***Brachoria splendida* (Causey), new combination**

FIGURE 8*d–f*

Cleptoria splendida Causey, Ent. News, vol. 53, pp. 167–168, fig. 5, 1942.
Tucoria spendida, Chamberlin, Bull. Univ. Utah, biol. ser., vol. 8, No. 2, p. 17, 1943.
Tucoria dynama Chamberlin, Proc. Acad, Nat. Sci. Philadelphia, vol. 99, p. 29, fig. 16, 1947.

DIAGNOSIS: Distinguished from all other species of the genus by the presence of a very pronounced ridge along the cephalic side of the distal half of the postcingular portion of the telopodite of the male gonopod.

DESCRIPTION: Length of male holotype, 49 mm.; width, 11 mm.; length of other male specimens, 45–49 mm.; width, 10–11 mm.

Collum subellipsoidal, edges somewhat irregularly curved, ends of paranota narrowly rounded; paranotal swellings absent; ridges on cephalic margins of paranota present only on proximal half.

Paranotal swellings absent on segments 2 and 3, present on 4th and all succeeding segments. Paranota of segment 2 and all succeeding midbody segments rather square, those from segment 8 on with caudolateral corners produced very slightly caudad.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of prominent processes; sternum of 5th legs with pair of weak, widely separated processes; sternum of 6th legs with no processes.

Coxal armature moderate.

Male gonopods large (about 2.0 mm. in telopodite arc length and 2.7 mm. in arc width); heavy and stout; curving mesiad, then cephalodorsad, then dorsad; distal half of postcingular portion of telopodite very heavy and bulky, a very prominent ridge extending along cephalic side, telopodite slightly excavate on caudolateral side of this ridge, seminal groove following this ridge to its end and then moving out on peglike solenomerite; cingulum large and conspicuous; precingular and postcingular portions of telopodite subequal in length. Prefemoral spine irregular, sometimes small, sometimes moderately long and strong, often with a small accessory spine near its base.

Color dark brown above with yellow on paranota and a median yellow spot on caudal margin of each tergite including collum; collum with an additional median yellow spot on its cephalic margin, the two yellow spots almost uniting to form an hour-glass mark; legs and underparts pale yellow.

TYPE LOCALITY: Pine Mountain State Park, Bell County, Ky. This is also the type locality for *Tucoria dynama* Chamberlin.

TYPE SPECIMENS: In the Academy of Natural Sciences of Philadelphia.

NEW DISTRIBUTION RECORD:

KENTUCKY: Harlan County: Pine Mountain, July, 1946 (1 ♂), W. L. Necker and C. K. Necker.

DISCUSSION: I have examined the holotypes of both *splendida* and *dynama* and find them to be conspecific. Therefore, Chamberlin's name will have to be regarded as a synonym of *splendida*, as indicated by Chamberlin and Hoffman (1958).

Brachoria tenebrans (Hoffman)

FIGURE 9*a–d*

Anfractogon tenebrans Hoffman, Proc. Biol. Soc. Washington, vol. 61, pp. 94, 96, figs. 1–3, 1948.

Brachoria tenebrans, Chamberlin and Hoffman, U. S. Nat. Mus. Bull. 212, p. 25, 1958.

DIAGNOSIS: Distinguished from all other species of the genus by the shape of the distal portion of the telopodite of the male gonopod as described below.

DESCRIPTION: Length of male holotype, 43 mm.; width, 11.9 mm.; length of other male specimen, 45 mm.; width, 11.5 mm.

Collum subellipsoidal, closely resembling that of *initialis*, ends of paranota rather narrowly rounded; no paranotal swellings present; strong ridges along cephalic margins of paranota.

Paranotal swellings not present on 2d segment, present but weak on 3d segment, stronger on succeeding segments. Paranota of 2d and 3d segments with caudolateral corners rather sharp, lateral edges curving strongly cephalomesad from corner; paranota of segments 4–7 rather square; paranota of segment 8 and succeeding midbody segments with caudolateral corners produced caudad slightly.

Sternum of 3d pair of legs with usual processes; sterna of 4th and 5th legs each with pair of low moundlike processes; sternum of 6th legs smooth.

Coxal armature very weak.

Male gonopods of medium size (about 2.5 mm. in telopodite arc length and 1.7 mm. in arc width); curved mesiad, then mesiodorsad, then abruptly cephalad, then abruptly laterodorsad, then caudodorsad, then laterad; a very prominent ridge along cephalically directed portion; a prominent tooth on caudal side of dorsally directed portion in holotype, this tooth not so prominent on specimen from Lawrence County. Prefemoral spine rather short but strong.

Color faded but suggests bimaculate type pattern.

TYPE LOCALITY: Winston County, Ala.

TYPE SPECIMENS: Male holotype and male paratype in the U. S. National Museum.

NEW DISTRIBUTION RECORD:

ALABAMA: Lawrence County: Kings Cove, June 29, 1950 (1 ♂), G. E. Ball.

DISCUSSION: The author has on hand a specimen from a location considerably north of the type locality for this species. This specimen shows a number of minor differences in the distal end of the telopodite of the male gonopod. These differences are not deemed worthy of nominal recognition. For a description and drawing of the type specimen, the reader is referred to Hoffman's original description (1948a). The description given above is based primarily on the new specimen and most of the drawings are of this specimen.

This specimen, the gonopods of which more closely resemble the usual *Brachoria* type, plays an important role in the decision to consider *Anfractogon* as a synonym of *Brachoria*. The modifications of the distal end of the telopodite in this species are no more elaborate than those found in *electa* and *hoffmani* which they somewhat resemble. Unusual modifications of the distal end of the telopodite seem to be the rule rather than the exception in this genus.

Brachoria turneri, new species

FIGURE 9*e–g*

DIAGNOSIS: Distinguished from all other species of the genus by the combination of the simple form and great bulk of the telopodite of the male gonopods.

DESCRIPTION: Length of male holotype, 45 mm.; width, 10.5 mm.; length of females, 47–50 mm.; width, 11.5–12 mm.

Collum subellipsoidal, edges gently curved, ends of paranota rounded; paranotal swellings absent; ridges along cephalic margins of paranota absent.

Paranotal swellings absent from 2d segment, very weak on 3d segment, somewhat stronger on 4th and succeeding segments. Paranota of segments 2–4 rounded; paranota of segments 5–13 rather square; paranota of posterior segments bluntly triangular.

Sternum of 3d pair of legs with usual processes; sternum of 4th legs with pair of very weak processes; sterna of 5th and 6th legs with no processes.

Coxal armature weak.

Male gonopods large (about 2.3 mm. in telopodite arc length and 2.5 mm. in arc width); curved mesiad, then rather abruptly dorsad; portion of telopodite distal to point of strongest mesial curvature very wide, much wider than more proximal portion; a curving ridge along

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causal side of distal portion of telopodite; extreme distal end of telopodite tapering to a subacuminate end; cingulum located midway between point of strongest mesial curvature and point of abrupt dorsal curvature; precingular and postcingular portions of telopodite subequal in length. Prefemoral spine weak.

Color somewhat faded but indicates dorsum was dark brown with light paranota and a light band across each tergite along caudal margin; collum with a band across cephalic margin as well.

TYPE LOCALITY: Bluff along North Fork Holston River, 2 miles southeast of Hayters Gap, Washington County, Va. Known only from the type locality.

TYPE SPECIMENS: Collected by Leslie Hubricht, July 15, 1950. Male holotype and female allotype in the U. S. National Museum. Female paratype in the author's collection.

DISCUSSION: This is another species intermediate between the old *Brachoria* and the old *Tucoria*. Assignment of *turneri* to either of these genera would have been purely an arbitrary decision. Perhaps this species, more than any other, shows that the old generic separation is untenable and should be abandoned.

I take great pleasure in naming this species for my advisor and friend, Dr. E. Craig Turner, Jr.

Brachoria viridicolens (Hoffman), new combination

FIGURE 9*h–j*

Tucoria viridicolens Hoffman, Journ. Washington Acad. Sci., vol. 38, pp. 349–350, figs. 5, 6, 1948.

DIAGNOSIS: Distinguished from all other species of the genus by the presence of four small spines on the outer surface of the postcingular portion of the telopodite of the male gonopods.

DESCRIPTION: Length of male holotype, 40 mm.; width, 9.3 mm.

Collum subellipsoidal, ends of paranota rounded; paranotal swellings absent; presence or absence of ridges along cephalic margins of paranota unknown to author.

Paranotal swellings absent from segments 2 and 3, weakly present on segment 4 and all succeeding segments. Paranota of segments 2–4 rounded, those of segments 5–14 rather square.

Sterna of 3d, 4th, 5th, and 6th pairs of legs each with a pair of processes.

Coxal armature very weak.

Male gonopods of medium size (about 1.7 mm. in telopodite arc length and 1.8 mm. in arc width); telopodite broad; curving cephalo-

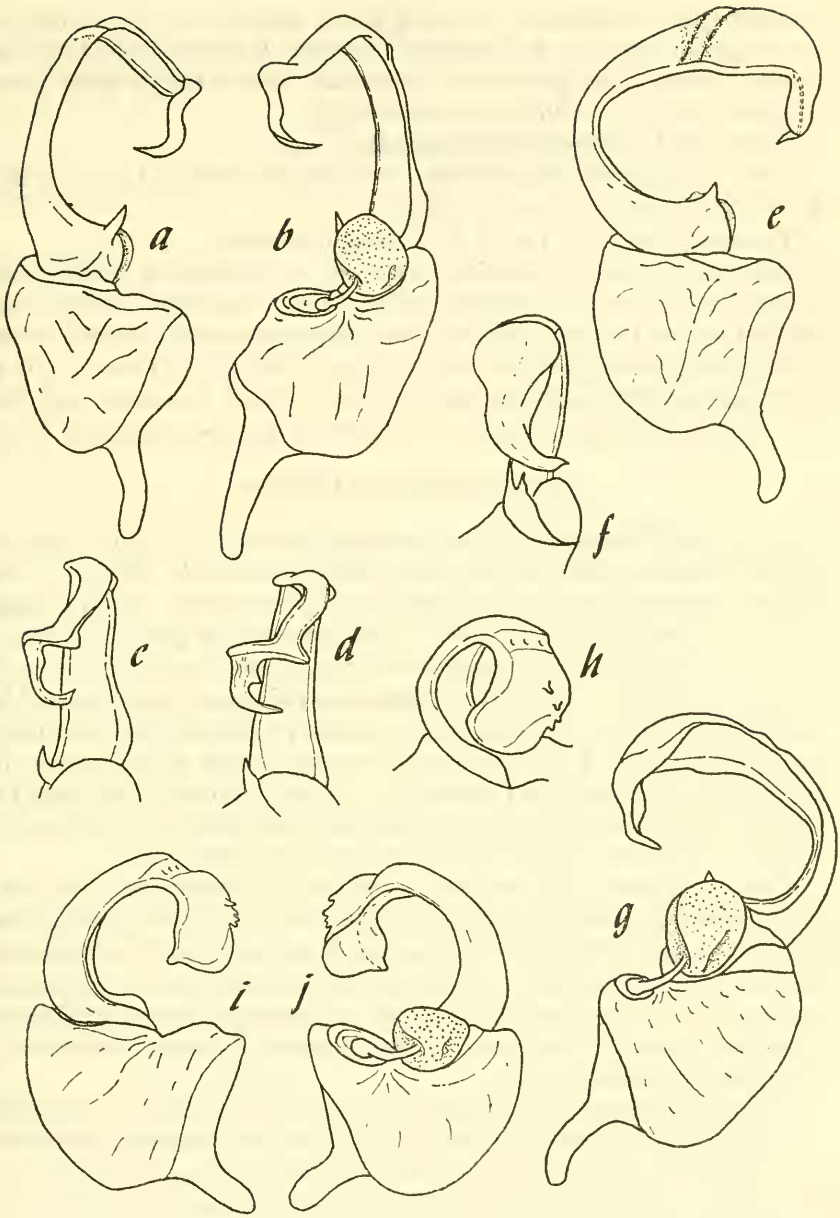

FIGURE 9.—Left male gonopods of species of *Brachoria*. *a–d*, *B. tenebrans: a–c*, cephalic, caudal, and mesial views of specimen from Lawrence County, Ala.; *d*, mesial view of holotype. *e–g*, *B. turneri:* cephalic, mesial, and caudal views. *h–j*, *B. viridicolens:* mesial, cephalic, and caudal views of holotype.

mesiad, then laterodorsad; 4 small sharp spines on outer surface of postcingular portion of telopodite; a small knoblike apical solenomerite; precingular portion of telopodite much longer than postcingular portion. Prefemoral spine absent.

Color faded, but indicates bimaculate pattern.

TYPE LOCALITY: Trace Creek, Greensbury, Green County, Ky. Known only from the type locality.

TYPE SPECIMEN: In the U. S. National Museum.

DISCUSSION: Although this species was first described by Hoffman (1948b) as *Tucoria viridicolens*, it lacks the complexity of the distal portion of the telopodite of the male gonopods characteristic of the other species which have in the past been referred to *Tucoria*. It is thus another form intermediate between the old *Brachoria* and *Tucoria* and adds another link to the chain of species connecting them.

Phylogenetic Relationships

Any attempt to construct an adequate picture of the phylogeny of a group with no fossil record is obviously exceedingly difficult. Decisions concerning relative primitiveness of characters are to a large extent necessarily subjective, and it follows that the process of choosing a starting point for an evolutionary tree is one fraught with opportunities for error. Even after a beginning point has been chosen, the construction of the tree itself is a matter of choosing between many possibilities, each of which may have many points in its favor. In spite of the acknowledged limitations of such studies, it is often instructive to indicate as far as possible the more probable relationships existing within any group of animals under consideration.

The distribution patterns of the species of *Brachoria* indicate that the most likely center of distribution for the genus is the general area of southwestern Virginia, southeastern Kentucky, and northeastern Tennessee. The majority of the known forms occurs in this region and, as more collecting is done, new records are being established closer and closer to the area for many species formerly known only from more distant localities.

I consider *Brachoria hansonia* to be the nearest of the known species to the primitive type of the genus. The form of the male gonopod in this species is very simple in its structure and could easily have given rise to the more complex gonopods of the other species. In addition, it most closely approaches the basic form in related genera such as *Apheloria* and *Sigmoria*. Indeed, if the cingulum were not present there could be no hesitation about placing *hansonia* in *Apheloria*.

It seems probable that *Brachoria separanda* arose from the *hansonia* stock and developed the swollen portion of the telopodite of the

gonopod and the two very noticeable bends in the telopodite. Apparently *calcaria* is a more specialized derivative of this line.

The two subspecies of *eutypa* and the more highly specialized *hamata* are obviously closely related, the prototype of the former probably giving rise to the latter. These species show resemblances to *separanda*. Another species, *plecta*, provides some evidence for this connection, as it has the swollen portion of the telopodite found in

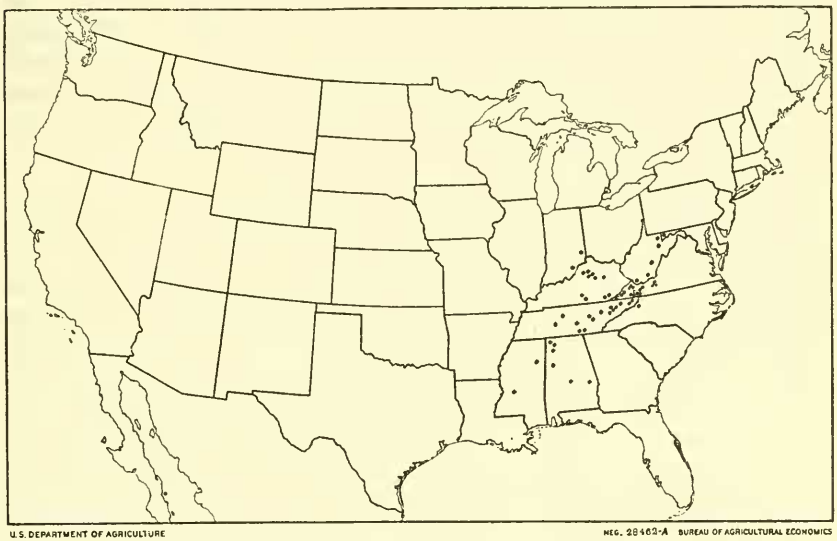

FIGURE 10.—Distribution of the genus *Brachoria*. The dots indicate the known localities from which specimens have been collected.

separanda but more distally it resembles *eutypa*. Though the twisted nature of the distal portion of the telopodite and certain body characters to be mentioned later indicate that this species is somewhat specialized, it may have arisen from an early branch of the *separanda* line that also gave rise to the *eutypa* line.

One other species should be mentioned here. Though the gonopods of *turneri* are large and heavy, their form is simple and there is no solenomerite. It seems possible that this species is an early derivative of the *separanda* line, which has independently attained larger gonopods. Thus it appears that the large bulk formerly thought to distinguish *Tucoria* does not always even indicate close relationships.

With the exception of *Brachoria plecta*, all the above species show one gonopod character in common. When viewed mesially, the telopodite arc tends to curve caudally. In addition, most of them agree in certain body characters which will be discussed later. On the basis of these characters, another group of species seems to be naturally

separated from the *separanda* group in spite of some superficial similarities between the less specialized members of the two groups. When viewed mesially, the telopodite arcs of the gonopods of the members of this group tend to curve cephalically, though the more primitive species show this condition only slightly.

The type of the genus, *B. ochra initialis*, has gonopods but little advanced over the basic type. The curvature tends only slightly cephalically. The sharp bend in the telopodite is distinctive. Apparently *cedra* and *electa* are derivatives of the *ochra* line. Both show indications of the same kind of telopodite bend as that occurring in *ochra*. *B. tenebrans*, though highly specialized, is easily derived from an *ochra*-like ancestor by modification of the distal portion of the telopodite and increase in gonopod size. The sharp bend and shoulder of *ochra* and *cedra* is still retained in this species.

Slightly advanced over the *ochra* group and lacking the sharp bend in the telopodite is *indianae*. In this species the curvature of the telopodite typical of this second major branch of the genus is very pronounced. The general form of the gonopods still somewhat resembles *ochra*. The gonopods are still small as are those of *ochra*, *cedra*, and *electa*. It would seem that *indianae* arose from the early *ochra* line before the sharp bend had arisen in the latter species.

This branch of the genus apparently led to a group of species with heavy, bulky, complex gonopods. Speculations regarding relationships within this group are exceedingly difficult inasmuch as there are many conflicting matters to consider. Characters that must be considered include the size and bulk of the gonopods, the presence or absence of a solenomerite, the presence or absence of a terminal plate, the relative length of the postcingular portion of the telopodite, and the complexity of the form of the gonopods. Which of these characters is more important as an indication of relationships is unknown. Since different conclusions can be reached depending on which characters are stressed, it must again be emphasized that the possible relationships shown in the accompanying diagram are open to much question.

The three species *viridicolens*, *kentuckiana*, and *calceata* have much smaller gonopods than do the other members of this group. This would seem to indicate that they are more primitive. In most of the other characters mentioned above, however, they are much advanced and apparently highly specialized. Another species, *ligula*, has much simpler, less bulky gonopods but they are considerably larger. In this instance I believe it probable that small gonopods have been maintained from the early *ochra-indianae* stock and that those species such as *ligula*, *splendida*, *laminata*, and *hoffmani* with larger gonopods have each independently evolved this characteristic.

B. ligula seems to be near the main line leading from the early *indianae* type to the more complex types in this group. In this species there is a noticeable increase in the bulk of the gonopods and a solenomerite has been developed.

It seems quite probable that the line leading from *ligula* to the more highly specialized forms in the group split into two main branches, one leading to *vividicolens* and eventually to the more complex *splendida*, and the other leading to the forms with terminal plates or homologous structures and typically with toothed solenomerites. Within the latter group, *calceata*, *laminata*, and *kentuckiana* all rather closely resemble each other and it would be difficult to say with any assurance just what their true relationships are. One possible grouping is shown in the diagram.

B. hoffmani presents a perplexing problem. This species has a terminal plate but no solenomerite. In addition, the postcingular portion of the telopodite is long, while it is very short in both *laminata* and *kentuckiana* and but little longer in *calceata*. Placing *hoffmani* in any scheme of relationships is thus quite difficult. It is without doubt a highly specialized form and its true affinities have been obscured. For want of a better solution, *hoffmani* is shown in the phylogeny diagram (fig. 11) as arising early from the *calceata* line.

It is interesting to note that, with the exception of *hoffmani*, there seems to be a general tendency in the entire *ligula* group towards reduction in the length of the postcingular portion of the telopodite.

The three species *glendalea*, *hubrichti*, and *falcifera*, though easily derived from the *hansonia* type, do not seem to fit well into either of the above-mentioned major groups. Therefore, each is considered to have arisen independently from the *hansonia* line.

All the above speculations as to phylogeny were based primarily on gonopod characters. On this basis the accompanying diagram was drawn. After this had been done, two other characters not previously considered were selected and the evidence presented by them was compared with the diagram. These two characters—the ridge of the collum and the shape of the midbody paranota—are not in any way associated with the genitalia, yet they show much agreement with the relationships shown. In general the species on the right side of the chart (excluding the *dentata-insolita* group which will be mentioned later) have no collum ridge and have rounded paranota, while those on the left side have collum ridges and square or produced paranota. Exceptions in the case of collum ridges are *plecta* and some specimens of *eutypa eutypa*. Exceptions in the case of the midbody paranota are *plecta*, *eutypa eutypa*, *turneri*, and *ligula*. The first three have square paranota but there is no indication of their being caudally produced at the caudolateral corners. *B. ligula* is the only species

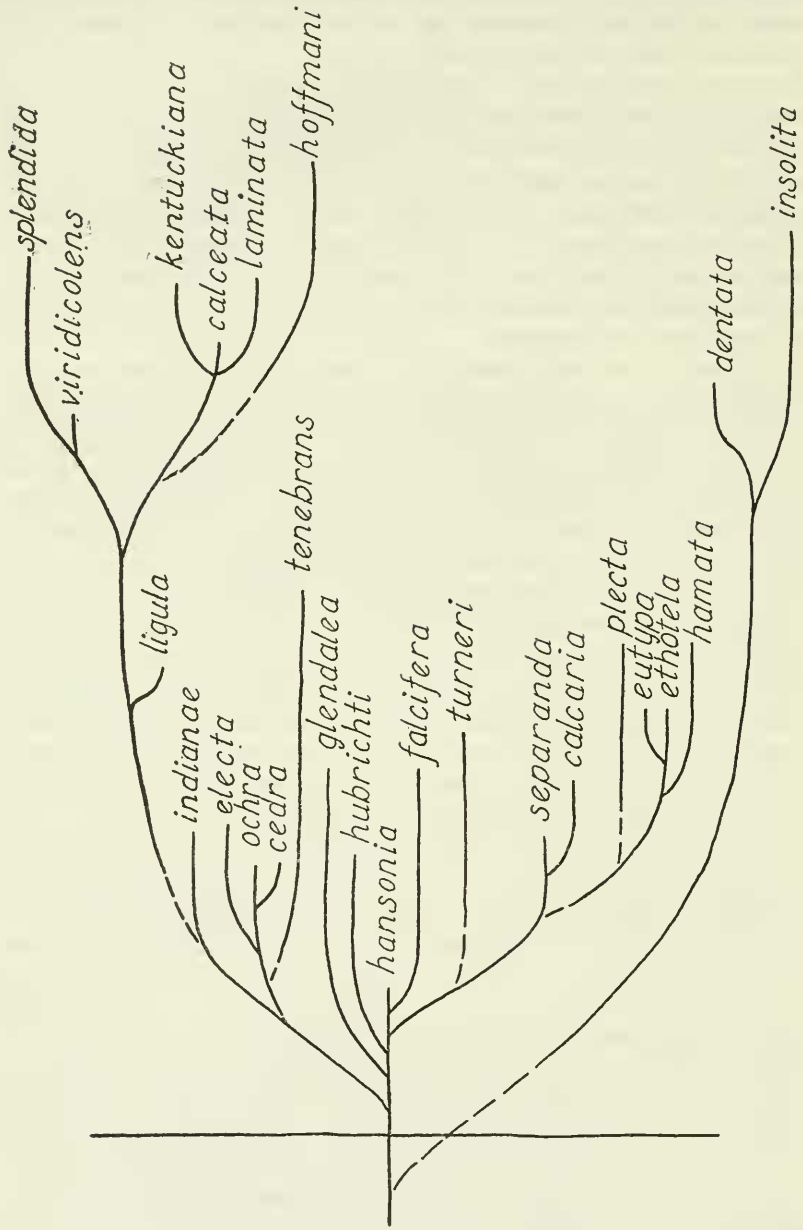

FIGURE 11.—Diagram of possible phylogenetic relationships of the species of the genus *Brachoria*.

on the left side of the chart that has rounded paranota. It is interesting to note that, in both body characters mentioned, *plecta* and *eutypa eutypa* fail to agree with their group. This would appear to be a secondary condition inasmuch as their gonopods definitely link them with the *separanda* main group.

The two species *insolita* and *dentata* obviously form a group to themselves on the basis of the location of the cingulum. They are believed to have diverged very early from the ancestral line of the genus.

No attempt has been made to show *mendota* in the phylogeny diagram as it is so highly specialized that, at present, its relationships are totally obscure to me.

It is to be hoped that extensive collecting in the future will help to clear up many of the perplexing questions indicated above. The true and complete picture will doubtless never be known, but perhaps in time the over-all trends can be established. If the purely speculative suggestions made in this paper help to stimulate further inquiry, they will have served their purpose.

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